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The Frankfort Exposition. A LETTER from our European correspondent gives an idea of the present condition of the International Electrical Exhibition at Frankfort. At the time of writing it is in anything but a completed state; the exhibits are only partially there, and, in particular, the long distance power transmission from Lauffen is not likely to be ready until the latter part of September, although every effort is being made to hurry it on, and the contractors are under heavy penalties to complete the work immediately. Aside from this plant the principal interest in the exposition centers around the Electro-Technical Congress to be held next month. It will begin on Monday evening, Sept. 7, with a reception to the delegates, and will close on Sunday night, Sept. 13, with a fête and display of fireworks in one of the parks. A large number of celebrated electricians from all over the world have promised to be present, and a considerable number of papers are already announced. Altogether the congress is likely to be a scientific gathering of no small importance, and to add to our own interest in it several very well known American electricians will be present, and two Profs. Carhart and Dolbear, will offer papers.

The City and South London Railway. OUR cable dispatch this week gives the net results of the first half year's operation of this unique road. It is promising, although not altogether satisfactory. The net profits have been a little over $20,000, an amount only sufficient to pay the interest on the bonds. The total operating expenses per train mile were about 53 cents, which strikes one as being decidedly high; it is certainly high compared with the expectations of the promoters. It will be decidedly interesting to learn whether Mather & Platt, the constructors, are safe in their guarantee of a maximum cost of seven cents per train mile for motive power. Comparisons with American enterprises might be made, but would not be especially instructive on account of totally different conditions. The City & South London Road, as the only underground electric system, is a useful example for the contemplation of those who propose engaging in similar enterprises elsewhere; taken altogether its operation has been very satisfactory, there have been some slight difficulties, but the failures have, as a rule, not been electrical, and could not be fairly charged up to imperfections in the motor system employed. Concerning ventilation, a question that has been much mooted in connection with the proposed underground system in this city, opinions seem to differ very widely. Some of those who have ridden upon the line say that is eminently agreeable, while others aver that the atmosphere in the tunnel is nothing short of miasmatic. The cars are kept closed for the most part, and consequently are not well ventilated. How much of the allegations against the tunnel are due to the closed cars it is not easy to say. It might be added that information concerning the actual experience obtained in this half year's operation is very difficult to get hold of; for some reason, good or bad, the managers of the road are as mum as oysters as to the details of the work. Nevertheless the road may be classified as fairly successful, and, considering the desperate conservatism of our English cousins, opponents of electric traction can find little consolation in the results of the first six months.

Sustaining Patents. A LETTER from a well-known patent attorney, which will be found in our columns, contains, albeit it is of a partisan character, a great deal of hard common sense. The inventor oftentimes must ask himself the question, What is the use of a patent if it proves to be merely a somewhat expensive admission ticket to a colossal litigation? Electrical patents especially have been in a state of turmoil for the last ten years. Many of those viciously litigated were worthless from the very start, and others of more or less merit have become so entangled that it is hard to tell anything of their real value. In the early stages of the art a good many broad patents were granted, and these have often come in conflict. Of late the tendency has been very strong towards sustaining some of these fundamental patents. The telephone decision, the Edison lamp decision, the Brush storage battery decision, and the Brush double-carbon arc-lamp decision, have all been in this line of strengthening ground patents. In each case the decisions have been as broad in their character as could possibly be derived from the claims under any reasonable interpretation. Considering the fact that the claims were granted when even the inventors could hardly realize their importance, and the examiners could not properly comprehend their sweeping character, the interpretations placed upon them have perhaps gone to extremes, but one thing they have done and done well; they have given inventors and investors the confidence in patent rights that had been most seriously shaken during the past few years. On the other hand, the very broad claims sustained have served as a lesson to the patent office, and the infringement suits brought in the remaining years of the century are likely to involve more questions of fact and fewer of interpretation. The next interesting group of infringement cases on the docket is that involving the fundamental electric railway claims. This fight, which is now impending, involves nearly all the companies engaged in the business and a score or so of more or less conflicting patents. It will be fun for the lawyers, but rather hard on the litigants. The patents of Adams, Field, Henry, Sprague, Van Depoele, Forbes, and others, form fighting material enough to last for ten years.

"We Sell Stock." A PROMINENT electrical fakir once remarked, speaking of the company of which he is the Pooh-bah, "We do not sell apparatus, we sell stock." This remark doubtless reflected the intention of the speaker, and may well serve as the text for a very brief sermon on over capitalization. It is not unusual to note the organization of some electrical company, with a capital anywhere from 500,000 to 5,000,000 of dollars, to exploit Stepandfetchit's electrodynamic tocsin, Thingembob's indestructible battery, or Spoopendyke's aerial navigator. The promoters in each case, it is presumed, are discreet and responsible men. If so, do they realize, we wonder, the kind of work that they are doing? Do they seriously believe that Stepandfetchit's Electrodynamic Tocsin Company, which is capitalized for $1,000,000, of which $950,000 goes to the inventor and promoters, and $50,000 is working capital, will really at any time during the lives of the present generation yield the $50,000 annual net profits necessary to keep the stock within speaking distance of par? If they do so believe they have a childlike confidence in the certainty of earning 100 per cent. on the money invested that is something truly marvelous. If they do not, they must realize that they are lending their best energies to the task of giving a purely fictitious value to securities which they intend to unload upon an unsuspecting public. Such a course may be legally defensible, but it is morally obnoxious to any self-respecting conscience. If you, O, worthy president of the Spoopendyke Aerial Navigation Company, Limited, really think that it will ever pay reasonable dividends, inasmuch as the stock cost you little or nothing, why do you not hold on to it and reap the benefits? You need not tell the old, old story about desiring to let the dear public share the great profits of this splendid invention; at this stage of the game it is altogether too thin. Human nature is not built that way, and if you propose to foist your stock on those who are ignorant enough to buy it under the impression that it will pay dividends, are you a whit more honest or honorable than the humble fakir on a Coney Island boat who sells Chinese lily bulbs, made of gaudily painted wood, and gets thirty days on the Island for so doing? To speak seriously, one of the things that makes it very difficult to float electrical stocks at the present time is the tendency toward capitalization at a figure unreasonable at first sight, and doubly so on investigation. Issue the capital stock on a conservative basis and investors will not be afraid of it. Now and then we see a company arranged in this straightforward, business-like way; such an one, for instance, recently started to do business in an important and lucrative field with only $50,000 capital, all paid up. If this example were followed more frequently it would be a very easy matter to obtain plenty of money for any legitimate electrical enterprise.

Rapid Transit or Otherwise. SOMEHOW the lucubrations of the Rapid Transit Commission do not result in anything substantial with the rapidity that might be desired. Of course the engineers must earn their salaries and some show of progress must be made; a great work like the one contemplated cannot be begun in a day, and yet it would seem as though something more substantial than a suggestion of routes, and a series of borings to discover new difficulties, ought to result before long. Meanwhile the cable construction on Broadway is going on with a rapidity that quite puts to shame ordinary engineering works in this city. There is probably no line in the world better fitted to exhibit both the good and bad features of cable construction than Broadway. The road is not a long one, there are few curves or grades, and the mass of travel is almost indescribably great. The result of this will be that the road will be easily kept in repair, the cables should show a very satisfactory life, and the efficiency of the system is likely to be higher than has ever been reached on a cable road, unless perhaps in the altogether exceptional line across the Brooklyn Bridge, which really requires special classification. The cost of construction is of course enormous, but the receipts are correspondingly great, and of the financial wisdom of the move there is no sort of question. Nevertheless the vices of the cable road can be displayed on Broadway as nowhere else in the civilized world. The system has two great, and numerous small, bad habits. First may be mentioned the stoppage of an entire cable at once, giving several thousand passengers the pleasant task of walking to their respective destinations, or else wearing out their tempers and the car seats for anywhere from five minutes to five hours while repairs are being made. This is intensely exasperating but not at all dangerous. Fancy, however, the result of a broken strand of cable catching in the grip and allowing the car to run amuck until there follows a collision sufficiently serious to tear the strand loose, or break the grip. Imagine, for example, this accident occurring just below Fourteenth street and Broadway about 2 o'clock some sunny afternoon, and the car running up a dozen blocks or so. The consequences are anything but pleasant to contemplate. Or, for a milder catastrophe, the corner of Broadway and Fulton street would present opportunities for wholesale destruction of property and life that are hardly to be matched. Real rapid transit is crawling along at a snail's pace, while the counterfeit kind such as is offered by the cable road is making long and rapid strides. Here is an opportunity for our storage battery friends. The recent decision sustaining the Brush patent puts the accumulator of to-day to a very large extent into the hands of the well-known company whose system has been used on the Fourth avenue road; they ought to take hold of the work with a vengeance now and accomplish something substantial. An effective line on Fourth avenue would be hailed as a public benefaction, and might deflect quite a considerable part of the Broadway traffic to itself, especially after an accident or two should have taught the public how unpleasant and dangerous can be the progress of a cable car through a crowded street.

Latest Foreign Electrical News.

(By cable from our Own Correspondent.)

London, Aug. 10, 1891.—The results of the first half year's working of the City & South London Railway have just been made public. Two million four hundred and twelve thousand three hundred and forty-three passengers were carried and the train mileage footed up to 141,408. The gross earnings were £19,688 and the total expenses £15,520, leaving net earnings of £4,168; an amount only sufficient to pay the interest on the debentures. The net result is not as good as might have been wished, but gives promise of a fair paying traffic for the future. Full details of the operation of the road are not yet at hand, but what has been made public affords no good reason for di couragement. An unfortunate accident occurred on the system a few days since by which a passenger lost his life. It was not due to the train itself, but to carelessness in the management of one of the hydraulic lifts that carry passengers to the surface at the stations. A passenger tried to enter the lift while it was in motion, with the result that he was carried up against a beam and completely decapitated. At the inquest an unfortunate laxity in management of the lifts appeared. There was certainly no excuse for not closing in the lift entirely before it was set in motion. Had this been done the accident could not have happened. As it was the company was exonerated, but the coroner's jury called its attention to the point just mentioned, and was assured by the company's solicitor that it would receive immediate attention.

The Post-Master General announced in the House of Commons on Saturday last that the telegraph service had produced a surplus for the first time since the introduction of the present rates in 1883.

A bill will be introduced at the next session of Parliament for the adoption of an improved standard of light. Public opinion seems to favor the idea of the appointment of a committee of experts to decide on a definite Imperial standard. Some reform of this sort is much needed, for the standards of light have up to the present proved rather unsatisfactory.

NEW BOOKS.

Electric Transmission Hand-Book. By F. B. Badt. Pp. 97; 22 illustrations. Electrician Publishing Company, Chicago, Ill. Price $1.

Those who are already familiar with some of Mr. Badt's other similar volumes will readily appreciate the probable merit of the present addition to the list. It contains a considerable number of interesting details concerning calculations for the transmission of power. Mr. Badt apparently is no believer in alternating current transmission of power, but if he had followed the progress of the times a little more sharply he would have been aware that the alternating system for long distance transmission is looming up in a way that leads one to the conviction that it will find a very large amount of use in the class of work before mentioned. One curious error strikes the eye of the reader on page 26. It may be Mr. Badt's practice to allow five per cent. for sag in lines intended for the transmission of power, but we think the average lineman could detect a line strung according to this happy suggestion at a distance of several miles by its generally rickety appearance. In spite of some minor failings the book contains much that is of use and many tables containing convenient important information.

The Electrician Primers.—A Series of Primers on Electrical Subjects. Vol. I., Theory, and Vol. II., Practice. "The Electrician" Printing and Publishing Company, London. Illus. Price $1 per vol.

Under this title are collected a number of convenient and instructive little elementary discussions of various electrical topics. Books such as this occupy a somewhat anomalous position, since they are not sufficiently explicit for instructional purposes and for purely popular reading presuppose a familiarity with electrical language that is not generally found. They will, however, be of considerable service to the beginner in giving him correct, though elementary discussions of a good many things in which he is interested. They are necessarily brief, but on the whole are eminently satisfactory. The separate primers, 38 in number, cover a wide range of subjects, and may generally be relied upon as far as they go.

Telephones: Their Construction and Fitting. By F. C. Allsop. Pp. 191; 168 ills. Spon, London and New York. 1891. Price $2.

This addition to our telephonic literature purports to be a practical hand-book on the working and fitting up of telephones. It is really a popular and rather interesting description of a large number of forms of telephonic apparatus of various kinds, and, to a certain extent, instruction in their use. It is especially suited to the needs of the English public, inasmuch as it has its excuse for being in the breaking up of the telephone monopoly in that country, a condition unfortunately far from being the existing state of things here. It will be found, however, to contain much that is of use to the general reader, and is well worth a place on the electrician's library shelves.

Chapters on Electricity. By Samuel Sheldon, Ph.D. Pp. 100; 85 ills. New York, Charles Collins, 1891. Price $1.25.

This little book was originally prepared as an attempt to galvanize a certain amount of useful life into the fourth revision of that venerable book, "Olmsted's College Philosophy." Its purpose necessarily modifies its usefulness somewhat. Nevertheless it will be found to contain a very fair statement of the facts of elementary electricity expounded as a portion of general physics. The old canonical lines sacred to the memory of many departed scientific treatises have been followed quite closely, but this is a less serious objection in a general text-book than in one intended specifically for electrical instruction. An unusually satisfactory chapter for a text-book is that on terrestrial magnetism.

Electrical Practice in Europe as Seen by an American.—II.

Frankfort Electrical Exhibition.

From a general tour through the grounds and buildings, it appears that though there are already a large number of exhibits and attractions the exhibition is by no means completed. Everything is being done to complete it, but it is probable that it will not be in full running order until toward the end of August. The most interesting exhibit for the electrician will undoubtedly be the great power transmission from the town of Lauffen to the exhibition by means of high tension alternating currents. But this is still quite incomplete; in fact, there is nothing to be seen but the foundation. Whether this will be completed by Aug. 15, as promised, under penalty of a heavy fine, is still a question. The other large power transmission from a distance by the Lahmeyer company is also delayed and will not be finished for a number of weeks yet. Owing to these delays and to the fact that this is a general vacation time, technical engineers appear to have postponed their visits until the end of August and the beginning of September, and by that time all will probably be ready. The postponement of the congress from Sept. 5 to 12 may be taken as a sign that the authorities themselves do not expect to have the exhibition quite complete much before September.

The exhibition grounds are large and roomy. There is only one large building, the Machinery Hall, the other exhibits being in separate buildings. In the evenings there is literally a flood of light throughout the grounds; it is probably the largest amount of artificial light ever seen in an area of like size. Rows of incandescent lamps, numbering thousands of lights, outline the dome of the main building, the iron observatory tower and other buildings, giving a pleasing effect. In the middle of the grounds an artificial waterfall is built, fed by electric motors, which is brightly illuminated by invisible arc lamps of different and continually changing colors, making quite an attractive effect, though not nearly as imposing and beautiful as the luminous fountains at the Paris exhibition of 1889. Besides the waterfall, the grounds are made attractive by numerous neat and odd buildings, excellent music and numerous well-patronized "bierhallen."

The general arrangement of the exhibits is very good, and is a credit to the management. All those of one class are placed together in a separate building, so that the visitor can see all the exhibits of each class together, without looking for them all over the grounds. It is characteristic of the systematic and thorough methods of the Germans.

The impression obtained from a general tour of inspection is that as an exhibition for the general public it is a great success. No pains have been spared to make it as attractive as possible. The management in this respect has been very creditable. There are many exhibits arranged so as to be attractive, entertaining and in some cases amusing to the general public, at the same time being instructive to the layman. In many cases, however, the only thing electrical about an exhibit is that it is lighted by electricity or driven by an electric motor, often in an obscure place where it would not be seen unless attention was called to it. In many cases electricity has been made an excuse rather than a reason for exhibiting something. Although most of these exhibits are of little interest to the electrician, there are a number, such as engines, condensers, driving gear, etc., which are of considerable interest.

Among the exhibits for entertaining the general public may be mentioned the following, of which the more important will be described in detail in subsequent correspondence. In the theatre there are lectures for the layman on electrical subjects; also a performance, in pantomime, illustrating the early discoveries of electrical phenomena in an amusing way accompanied by an attractive ballet and picturesque tableaux and scenic effects. A submarine diver is exhibited operating in the bottom of a large glass tank, by the aid of electric light and apparatus; a large captive balloon operated by an electrical windlass; an observatory tower with an electrical elevator; telephonic transmissions from the Opera House in the city; gramophone and phonograph performances; a loud-speaking telephone; a miniature theatre stage showing what numerous and really fine light effects can be produced on a stage by means of electric light; an art gallery; an artificial underground mine with electrical appliances; several electrical railroads; an electrical boat on the river operated by accumulators. Also a boat of aluminium with a benzine engine.

For the technical engineer there is at present comparatively little of novelty. The great number and wide circulation of electrical journals and the reports of papers read in engineering societies contain such thorough descriptions of novelties in electrical matters that any exhibition at the present time merely affords the visitor a chance to see and examine that which he has already read about in the journals. There appears to be comparatively little that has not already been described.

Perhaps the most interesting subject for the engineer is the alternating current transmission and the motors, particularly the "drehstrom" system, which consists of a three-wire system in which the phase of the alternating currents lags one-third of a wave length in the three successive wires; for instance, there is the same voltage between *each* two of the three wires, as shown by an incandescent lamp which burns equally bright between *any* two of the three wires. The chief advantage of such a current is in the running of motors.

Among the other exhibits are transmission of large powers by means of alternating and direct current motors; transformers for both kinds of currents; transformers for converting alternating into direct and *vice versa*. The more important of these will be described in detail in subsequent letters.

The exhibition of engines is particularly fine, and forms one of the largest parts of the exhibition in the machinery hall. The workmanship appears to be excellent judging from what one can see from a cursory inspection, and from the total absence in a number of cases of the slightest jar or trembling. If one did not see it one could hardly tell whether the engine was running or not. If the statements of the economy are correct, and it is likely they are, the engines and boilers are also well designed for economy of fuel. Among the accessories is a condenser requiring no cold water, for use in cities and other places where running water is expensive. The condenser is worked by a limited quantity of water which is cooled after it comes from the condenser, by means of a blast of air through a suitable cooling apparatus, and then used over again.

In the telephone and telegraph building there are apparently few novelties except in details. One of the conspicuous exhibits for an American is the one giving the entire credit of the invention of the telegraph to Soemmerring, a German, and that of the invention of the telephone to Reiss, also a German.

With the exception of quite a large exhibit from the Thomson-Houston company there appears to be nothing else from the United States at present, as the Weston exhibit of instruments has not yet arrived. There are so few exhibits from foreign countries that the exhibition cannot be said to represent the state of the art outside of Germany. But as a national exhibition it is probably a very good represention of the art in Germany.

Carl Hering.

Frankfort, July 24, 1891.

Another Note on Some Lately Manufactured Telephone Cables.

By Herbert Laws Webb.

In the opening paragraph of Mr. Perrine's article last week he says that "there is no department in electrical engineering concerning which accurate knowledge is so little diffused and difficult to obtain as that of the details of a telephone exchange, the requirements of the instruments, the switchboard and the line." No better justification of this statement could be offered than the figures given by Mr. Perrine in the latter part of his article. They are so wide of the mark and so obviously incorrect that it is difficult to understand how they could have escaped correction before being printed.

In the first place, the reference to the formula of Prof. Jacques and "Prof." Preece applying to the limit of distance of the telephonic transmission of speech is not a good statement of the case. The limit given by Prof. Jacques has long ago been exceeded. The KR of the long-distance line from New York to Buffalo, for instance, is considerably over 10,000, and this is a good example of every-day practice. According to Mr. Preece's formula, speech is impossible at 15,000, "possible" at 12,500, "good" at 10,000 and excellent at 8,000. In applying this formula to lines having any considerable length of underground or submarine cable, the limit of the KR is taken at about 8,000, so that Mr. Preece does not under any circumstances place the limit at 6,500. The opinion of telephone engineers in this country is that with a good overhead line and long-distance transmitters even the topmost limit of 15,000 set by Mr. Preece may be exceeded.

The comparison made by Mr. Perrine between the relative values of underground cables and overhead wires for telephone work is not at all clear, that is, the method by which he arrives at the comparison is not clear. Thirty-seven miles of pole line of No. 12 S. W. G. wire (the size generally used) would have a total resistance of 200 ohms, and a total capacity of about .4 microfarad; the mile of cable with which this length of line is compared has a resistance of 35 ohms and a capacity of .1 microfarad. The comparison in favor of the pole line is obviously greatly overstated; about 10 miles would be much nearer to the mark.

When we come to the speaking limit of the Roebling cable there is a far more startling difference between Mr. Perrine's figures and the true ones. The cause of the error is that Mr. Perrine has taken the KR *per mile*, instead of making it the product of the *total* resistance into the *total* capacity of the cable. It is a very simple error, and one

that has often been made before, always, of course, with the same wonderful results that are obtained in this case. Taking the New York cable, Mr. Perrine finds that according to Jacques' formula we could speak 736 miles with a Blake transmitter, and 1,650 miles with a Hunnings. If Mr. Perrine could make a cable that would really give these results, his fortune would be assured and he would be able to receive Mr. Preece's congratulations by telephone from London in a very short time.

The Roebling cable laid in New York has a slightly higher resistance than that given, the actual figure being 34.95 ohms per mile. Taking the capacity at .081 microfarad per mile, and the resistance at 34.95 ohms, the speaking limit would be as follows:

Jacques' limit for Blake transmitter....	KR = 2,000	27 miles.
" " " Hunnings "	KR = 4,500	40 "
Preece's " " underground work...	KR = 8,000	54.2 "

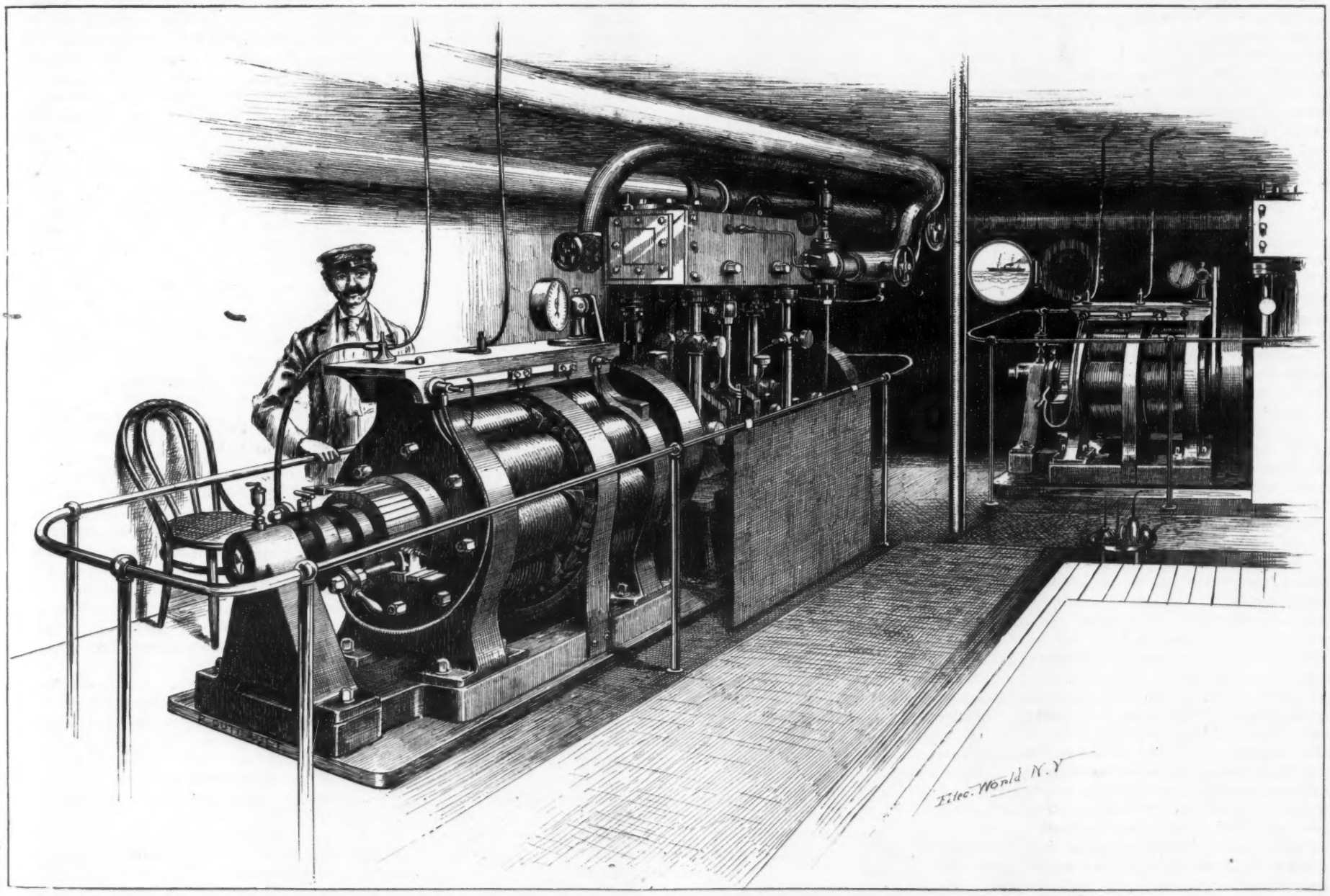
Such figures as 27 miles, 40 miles and even 54.2 miles look very insignificant beside such considerable distances as 736 miles and 1,650 miles. The KR of a cable of the particular type taken as an example, 736 miles long, would be 112,700, or nearly eight times higher than the limit which Mr. Preece's experiments have led him to put down as "impossible."

Electric Installation on the Steamship La Touraine.

One of the neatest and most effective marine plants that it has been our fortune to inspect in a long time is that to be found on La Touraine, the fine new steamer of the Compagnie Générale Transatlantique, running between New York and Havre. It is an installation of an unusual character, both in its location on the ship and in the type of machines employed. In the first place the dynamo room, instead of being, as usual, far down in the hold, hot, dark and uncomfortable, is on a level with the hurricane deck, with ports that can safely be thrown open a large part of the time, airy, cool and well lighted. It is a small square room in the deck house, with the dynamos and engines on three sides of it, the entrance on the fourth side, and the switchboard rising in the centre of the room within reach of the electrician's hand.

Our cut shows two of the three direct dynamos. They are all Desrozieres machines, a type very unfamiliar in this country and worth more than a casual description. It is a multipolar machine with a coreless disc armature; the field magnets, as will be seen from the cut, clasp closely an armature that has the general appearance of a wheel, and is, in fact, a thin disc built up of overlapping copper coils. The brushes, owing to their connection to the armature, are but two in number, and rest upon a commutator placed outside the field magnet structure and are thoroughly accessible. There is no core whatever, and from the construction of the armature so good ventilation is insured that a high current density can be obtained, and consequently the machine has a high weight efficiency. Those employed on La Touraine are of 300 ampère capacity each and about 100 volts normal electromotive force and they are compound wound. The series coils, however, are placed on only a portion of the magnet core. Each dynamo is coupled directly to a Bréguet engine of corresponding power. The speed is about 400 revolutions per minute. But two of the dynamos are in use at any one time, the third being held in reserve. Something over a thousand lamps are distributed over the ship, part of them being 16 c. p. and part *demi-lampes* of 10 c. p. The lighting is of a well designed and artistic character. Very many of the lamps have frosted bulbs, and most of them are well distributed instead of massed at a few points.

Steam is obtained by pipes from the main boiler room. The operation of this plant on the initial trip, at the end of which the sketch from which our illustration is taken was made, was thoroughly satisfactory. The machines run without noticeable heating, and are compact and efficient. The switchboard is a model of compactness and neatness. Its position enables it to be very readily reached when necessary, and all the measuring instruments can be seen at a glance. In particular several snap switches for heavy currents attract attention; they are of the revolving type, wherein the contacts are suddenly lifted, breaking the arc, and may then be revolved and snapped down in their proper position, a construction that has been to some extent adopted in this country. The installation was established by the Maison-Bréguet that manufactures the apparatus, and is altogether the most interesting and instructive marine plant that has recently fallen under our notice.



ELECTRIC LIGHTING PLANT ON THE TRANSATLANTIC STEAMSHIP LA TOURAINE.

The Montreal Convention.

Never before has such deep interest been taken in a meeting of the National Electric Light Association and for none of the past American conventions have such extensive preparations been made. The whole city of Montreal is taking pains to have the coming meeting of the electrical fraternity the most interesting yet held by the N. E. L. A.

Last week the executive committee for the reception of the members of the National Electric Light Association met in the Windsor Hotel. Prof. Bovey was in the chair, and there were present Messrs. John Carroll, A. J. Corriveau, W. E. Christie, W. L. Toms, E. C. Arnoldi, F. Fairman, John Kennedy, S. G. Stevenson, J. Kent, L. B. McFarlane, Phelps Johnson and G. W. Sadler. A letter was read from Mr. Bean, secretary of the association, in which he stated that Prof. Elihu Thomson and Edward Weston would attend the convention, and that there was a probability that Mr. Edison and Mr. George Westinghouse would also attend. Mr. James Harper, who had been asked to secure the co-operation of the press, reported, as vice-president of the Provincial Press Association, that the executive committee had decided to act, and would add to their number representatives to give each city newspaper a place on the committee, who would welcome the visitors as hospitably as they could. The programme is as follows:

Monday, September 7—8 P. M., formal opening of exhibition, possibly by His Excellency the Governor-General.

Tuesday—10 A. M., opening of the convention in Windsor Hall. Addresses of welcome by the Mayor and members of the Reception Committee. 4.30 P. M., drive through the city. 8 to 11.30 P. M., conversazione at Redpath Museum and Molson Hall, McGill University.

Wednesday, 9.30 A. M., fire department display on Dominion Square. 5 to 7 P. M., garden parties. 8 P. M., banquet at Windsor.

Thursday—8:30 A. M., Harbor Commissioners' trip down Rapids and visit to Caughnawaga. 5 to 7 P. M., garden parties. 8:30 P. M., lecture by Nikola Tesla, of New York.

Friday—3 P. M., lacrosse match, yachting parties. 8 P. M., concert at Sohmer Park.

Saturday—7 P. M., excursion to Quebec.

Electricity on a Modern Sugar Plantation.

Mr. H. C. Minor is one of the most progressive sugar planters in Terrebonne Parish, La. The "Southdown" plantation, owned by him, near Houma, La., will cut over eleven hundred acres of cane this season, and the experiment of hauling the cane at night with the aid of electric arc lights will soon be tried. He has purchased of Edward J. O'Beirne an arc-light plant of 70 2,000 c. p. lamps and an engine necessary to drive the dynamo. Twenty-five lamps will be used for lighting the sugar-house, and the others will be erected on the various roads leading through the canefields.

The sugar bounty of two cents per pound recently granted by Congress has greatly stimulated the sugar planters in their efforts to overcome the various obstacles always existing wherever a large crop is to be moved. Mr. Minor will receive about $80,000 as bounty for this season's crop. He is adding over $60,000 worth of new and improved machinery for handling not only his own but also the crops of neighboring planters.

Mr. O'Beirne has suggested the use of an electric railway to move the cane, and Mr. Minor thinks very favorably of connecting his "Hollywood" plantation with "Southdown," three miles distant, in this way. The outlook for electrical machinery, and the prominent part it will take in the operation of all well-conducted sugar plantations in the near future, is certainly a promising one.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1752.——Dalibard (Thomas François), French botanist and amateur in physics, carries out minutely the suggestions embodied in Franklin's printed letters and constructs an atmospherical conductor at Marly-la-Ville, about eighteen miles from Paris, where Nollet likewise experimented. Dalibard's apparatus consists of a pointed iron rod, one inch in diameter and forty feet long, protected from the rain by a sentry box, and attached to three long wooden posts insulated by silken strings.

On the 10th of May, 1752, during Mr. Dalibard's absence, an old soldier by the name of Coiffier, who was at the time employed as a carpenter and who had been left in charge, on observing the approach of a storm, hurried to the apparatus, prepared to carry out the instructions previously given him. It was not long before he succeeded in obtaining large sparks upon presentation of a phial to the rod, and these same sparks, which were all accompanied by a large snapping noise, were likewise obtained by the curate of Marly, Mr. Raulet, whom he had sent for and with whose assistance Coiffier subsequently succeeded in charging an electric jar. On the 13th of May, Dalibard made, to the French Academy of Sciences, a report of the results thus obtained by Coiffier, to whom belongs the distinction of having been the first man who saw the electric spark drawn from the atmosphere.

On the 18th of the same month, Mr. Delor, of the French University, drew similar sparks from a rod ninety-nine feet high at his house in the Estrapade, at Paris, and the same phonomenon was afterward exhibited to the French King. It is said that the conductor afforded sparks even when the cloud had moved at least six miles from the place of observation. Other experiments of a like nature were made a few days later by Buffon at Montbar, and, during the ensuing months of July and August, by Canton, in the vicinity of London. The last named, it is said, succeeded in drawing atmospheric electricity by means of a common fishing rod. (Dissertation Fifth, Eighth "Britannica," vol. I.)

An account of the Dalibard and Delor experiments was transmitted by the Abbé Mazéas, on the 20th of May, to the Royal Society of London.

The Abbé Mazéas erected, in the upper story of his residence, a magazine consisting of several insulated iron bars connected with the pointed rod. The lightning was brought into the house by means of a projecting wooden pole, having at its extremity a glass tube filled with resin which received a pointed iron rod twelve feet long. This apparatus was, however, too much exposed to afford reliable observations, and Mazéas therefore arranged to make more accurate experiments at the Chateau de Maintenon, during the months of June, July and October, 1753. The results he obtained were communicated to the English Royal Society by Dr. Stephen Hales.

Mr. Thomas Ronayne in Ireland, and Mr. Crosse in England (See "Account of an apparatus for ascertaining and collecting the electricity of the atmosphere") made use of long wires in horizontal positions insulated by being attached to glass pillars, but Mazéas, in his Maintenon experiments, attached the iron wire by a silken cord to the top of a steeple ninety feet in height, whence it entered an upper room of the castle, a total distance of 370 feet. With this, Mazéas ascertained that electric effects are produced at all hours of the day during clear, dry and particularly hot weather, the presence of a thunder storm not being requisite for the production of atmospheric electricity. He likewise observed a certain regularity of daily increase and decrease. In the driest summer nights he could discover no signs of electricity in the air, but when the sun reappeared the electricity accompanied it, to vanish again in the evening about half an hour after sunset.

See W. Sturgeon, "Lectures," London, 1842, pp. 182, 183; *Phil. Trans.*, vol. XLVIII., part I, pp. 370, 377, etc.; Dalibard's "Franklin," vol. II., p. 109, etc.; Nollet, "Letters," vol. I., p. 9; Franklin's Works, vol. V., p. 288; "English Cyclopædia, Arts and Sciences," vol. III., pp. 804-805; "Letters of Thomas Ronayne to Benjamin Franklin," at page 137 of vol. LXII. of *Phil. Trans.*, also Ronayne both in *Journal de Physique*, tome VI., and in the *Phil. Trans.* for 1772, vol. LII., pp. 139-140; Geo. Adams, "Essay on Elect.," London, 1785, p. 259.

A. D. 1752.——Freke (John), surgeon to St. Bartholomew's Hospital, London, gives, in the Second Part of "A Treatise . . . of Fire," the third edition of his "Essay to Show the Cause of Electricity, etc.," originally published in 1746, while in the Third Part of the same work he shows the "Mechanical Cause of Magnetism, and why the compass varies in the manner it does."

He says (pp. 90-91), "It had been impossible that this wonderful *Phenomenon* of Electricity should ever have been discovered, if there had not been such things as are non-electricable; for, as fast as this Fire had been driven on anything its next neighbor would have carried it farther; but, when it was most wonderfully found, that anything which was suspended on a silk cord (that being non-electricable) was obliged to retain the Fire, which by Electrical Force was driven on it; and when, moreover, it appeared, that any person or thing, being placed on a cake of bees-wax (which is also a non-electricable) could no more part with its Fire than when suspended in (*sic*) a silk cord; I think it will become worthy of inquiry, why they are not electricable." And, at page 136, he adds, "I think it a great pity that the word *Electricity* should ever have been given to so wonderful a *Phenomenon*, which might properly be considered as the first principle in nature. Perhaps the word *Vivacity* might not have been an improper one; but it is too late to think of changing a name it has so long obtain'd." In the Third Part, he explains that "by the Fire passing from and to the Sun, it so pervades iron aptly placed, as to make it attractive and produce the various operations of magnetism."

A. D. 1752.——In this year was published at Leipsic the "Biblia Naturæ," written by John Swammerdam, a celebrated Dutch natural philosopher (1637–1682), all of whose works were translated into English and published in folio during the year 1758.

At page 389 of the second volume of the *Biblia*, he thus alludes to one of many experiments made by him in 1678, before the Grand Duke of Tuscany: "Let there be a cylindrical glass tube in the interior of which is placed a muscle, whence proceeds a nerve that has been enveloped in its course with a small silver wire, so as to give us the power of raising it without pressing it too much or wounding it. This wire is made to pass through a ring bored in the extremity of a small copper support and soldered to a sort of piston or partition; but the little silver wire is so arranged that on passing between the glass and the piston the nerve may be drawn by the hand and so touch the copper. The muscle is immediately seen to contract."

Through Swammerdam, the Germans lay claim to the origin of what has been called galvanism. It certainly cannot be denied that the above-described experiment closely resembles that which made Galvani famous (A. D. 1786).

See Swammerdam's Biography, also Dissertation Fifth in the "Encycl. Britannica."

A. D. 1752.——On the 16th of April, 1752, is read before the Royal Society a letter written by John Smeaton, a very prominent English engineer and inventor, to Mr. John Ellicott, giving an account of the electrical experiments *in vacuo* made with his improved air pump at the request of Mr. Wilson. This account, fully illustrated, appears in the Society's Vol. LXVII. for the years 1751 and 1752, pp. 415–428.

He observes that upon heating the middle of a large iron bar to a glowing heat the hot part can be as strongly electrified as the cold parts on each side of it. He also finds that if anybody who is insulated presses the flat part of his hand heavily against the globe, while another person standing upon the floor does the same, in order to excite it, the one who is insulated will hardly be electrified at all; but that, if he only lays his fingers lightly upon the globe, he will be very strongly electrified.

See Wilson, "Treatise on Electricity," pp. 129–216.

A. D. 1752–1753.——Mr. de Romas, assessor to the presideal of Nerac, in France, repeats the experiment of Benjamin Franklin, and succeeds in bringing from the clouds more electricity than had before been taken by any apparatus. For this purpose he was the first to make use of a wire-covered string.

He constructed a kite seven feet five inches high and three feet wide, with a surface of eighteen square feet, and, having wound fine copper wire around a strong cord through its entire length of about eight hundred feet, he raised the kite to a height of five hundred and fifty feet on the 7th of June, 1753. Sparks two inches in length were at first drawn by a discharging rod, and, when the kite had reached an elevation of six hundred and fifty feet, he received many flashes of fire one foot long, three inches wide and three lines diameter, accompanied by a noise audible at a distance of five hundred feet.

On the 16th of August, Mr. de Romas raised the kite with about one thousand feet of string and obtained thirty beams of fire nine or ten feet long and about an inch thick accompanied by a noise similar to that of a pistol shot. ("Encycl. Britannica," Eighth Edition, vol. VIII, p. 582.) Three years later, Aug. 26, 1756, and also during the year 1757, De Romas obtained similar results from numerous experiments. He finally found much danger attending the raising of the kite and thereafter coiled the string upon a small carriage, which he drew along by means of silken lines as the cord was being unwound.

The researches of De Romas concerning the electricity of isolated metallic bars are embraced in six letters addressed by him to the Bordeaux Academy of Sciences between July 12, 1752, and June 14, 1753. They have never been printed but are kept, together with other manuscript matter of the same physicist, in the private archives of the institution.

The experiments of De Romas upon isolated bars were first repeated by Boze at Wittenberg, by Gordon at Erfurt, and by Lomonozow in Russia (*Phil. Trans.*, vol. XLVIII., part 2, p. 272). Mr. Verati, of Bologna, obtained the electric spark in all weathers, through a bar of iron resting in sulphur, and Th. Marin, of the same city, by means of a long iron pole erected upon his dwelling, studied the relationship of rain and atmospheric electricity (Musschenbroeck, "Cours de Physique," vol. I., p. 397).

See, also, *Journal des Savants* for October, 1753, p. 222; "Mémoire sur les moyens, etc.," par De Romas, Bordeaux, 1776; Sturgeon's "Annals, etc.," vol. V., p. 9; Harris, "Electricity," p. 176; Priestley, "History, etc.," 1775, pp. 326–329; "Mémoires de Mathématique, etc.," vol. II., p. 393, and vol. IV., p. 514; "Etude sur les travaux De Romas," p. 491, by Prof. Mergey, of Bordeaux, which latter work won a prize for its author in 1853; Becquerel, "Traité expérimentai, etc.," 1834, vol. I., pp. 42–43. See, likewise, the results obtained by Prof. Charles in "Traité de Physique Expérimentale, etc.," par Biot, Paris, 1816, vol. II., pp. 444, 446, and in Peltier's Introduction to his "Observations et Recherches Expérimentales, etc.," Paris, 1840, p. 7, as well as Brisson's "Dict. de Phys.," Paris, 1800, vol. II., p. 174 and "Mémoires des Savants Etrangers," 1755, vol. II., p. 406.

A. D. 1753.—M. Deslandes, member of the French Royal Academy of Sciences, is the author of "Recueil de Différents traités de Physique," the third volume of which contains his memoir on the effects of thunder upon the mariners' compass. He alludes to the observations made thereon by Dr. Lister, of London (well known by his "Historia Animalium Angliæ, Lugd., 1678"), as well as to many experiments made by Musschenbroeck and by others noted in the *Philosophical Transactions*.

A. D. 1753.——Prof. George William Richmann, native of Sweden and member of the Imperial Academy of St. Petersburg, who had long before constructed an apparatus for obtaining atmospherical electricity in accordance with Franklin's plans, was attending a meeting of the Russian Academy of Science, on the 6th of August, 1753, when his ear caught the sound of a thunder clap which appeared stronger than any he had previously heard. He hastened home in company with his engraver, Mr. Sokolow, and upon their arrival they found the plummet of the electrometer elevated four degrees from the perpendicular. Richman stooped toward the latter to ascertain the force of the electricity, and "as he stood in that posture, a great white and bluish fire appeared between the rod of the electrometer and his head. At the same time a sort of steam or vapor arose, which entirely benumbed the engraver and made him sink on the ground." Sokolow recovered, but Richman had met with instant death, owing to the fact that he had failed to provide means whereby the surplus electricity might discharge itself into the earth.

See "Library of Useful Knowledge," London, 1829; "Electricity," page 59, also page 33; Singer, "Electricity," p. 217; Harris, "Electricity," p. 177; *Phil. Trans.*, vol. XLVIII., part II., pp. 763, 765; also vol. XLIX., part I., pp. 61, 67; "La physique à la portée de tout le monde," par le Père Paulian, vol. II., p. 357; "Hist. de l' Acad. des Sciences," pour 1753, p. 78; "Franklin in France," 1888, part I., p. 5.

A. D. 1753.——Canton (John), an English savant, announces his most important discovery that vitreous or resinous electricity may be produced at will in the same tube. This he proves by taking a tube, which had been roughened by grinding it with thin sheet lead and flour of emery mixed with water, and which developed vitreous or positive electricity when rubbed with dry oil silk, and resinous or negative electricity when excited with new flannel. Rough quartz will, it is said, show like results. He also took a tube, of which only one-half had been made rough while the other half was polished, and he demonstrated that the different electricities are produced at a single stroke with the same rubber.

He also discovered that the exciting power of the rubber or cushion of the electrical machine will be greatly increased by applying to it an amalgam of mercury and tin mixed with a little chalk or whiting.

His very remarkable experiments upon many descriptions of tourmaline, reported to the Royal Society in December, 1759, were followed by many others detailed by Priestley, at pages 298–301 of his "History of Electricity," London, 1775, and Canton was the first to discover the electrical properties of the topaz, which latter were made known during the early part of the year 1760.

He was also the first to establish properly the fundamental fact of electrification by induction, or, as he terms it, "relating to bodies immersed in electric atmospheres," which afterward led Wilcke (A. D. 1757) and Æpinus (A. D. 1759) to the method of charging a plate of air like a plate of glass, and to make the most perfect imitation of the phenomena of thunder and lightning. (George Adams, "Essay on Electricity," London, 1799, pp. 351–356; Noad, "Manual," chapter I., and Priestley, "History, etc.," section 5.) The paper containing an account of Canton's experiments was read before the Royal Society December 6, 1753. The principle announced is that "the electric fluid, when there is a redundancy of it in any body, repels the electric fluid in any other body when they are brought within the sphere of each other's influence and drives it into the remote parts of the body; or quite out of it, if there be any outlet for that purpose. In other words, bodies immerged in electric atmospheres always become possessed of the electricity contrary to that of the body in whose atmosphere they are immerged."

Canton is the first to show that the air of a room can be electrified either positively or negatively, and can be made to retain the electricity when received. He thus explains his method: "Take a charged phial in one hand and a lighted candle insulated in the other, and, going into any room, bring the wire of the phial very near to the flame of the candle and hold it there about half a minute, then carry

* Continued from THE ELECTRICAL WORLD, Aug. 8, 1891.

the phial and candle out of the room and return with the pith balls (suspended by fine linen threads) held out at arm's length. The balls will begin to separate on entering the room and will stand an inch and a half or two inches apart when brought near the middle of it."

The construction of artificial magnets by Canton, through the combination of the Du Hamel (A. D. 1749) and the Michell (A. D. 1750) methods, as well as without the aid of natural loadstones or artificial magnets, is detailed by Noad at chapter XV. of his "Manual," London, 1859.

See *Phil. Trans.*, Vol. XLVIII., part I., pp. 350, 356, and part II., pp. 780, 782 and 784, also vol. XLIX., part I., p. 300, vol. LI., pp. 398, 403, and vol. LII., part II., pp. 457, 461; A. D. 1722, and A. D. 1752; *Gentleman's Magazine* for Sept., 1759. See, likewise, the *Phil. Trans.* for Monday, January 21, 1666, page 375, and George Adams' "Essay on Electricity, etc.," London, 1799, page 579, for method of making the artificial Bolonian stone or Canton's phosphorus.

A New Motor Truck.

The accompanying illustration shows a new truck invented by E. W. Goss, of Amesbury, Mass. The cut shows the motor and gearing mounted on 36-inch wheels. As will be noticed the armature shaft runs lengthways of the car, and has two gears of corresponding different diameters which mesh into two gears of different diameters fitted with friction clutches, on a shaft running parallel to the armature shaft, on each end of which are bevel gears meshing into gears on the axles. On each end of the car is placed a controlling stand with three handles. The upper one controls the speed of the car by a rheostat. The middle one is the reversing lever, and the lower one connects to the two clutches. By the use of this lower lever the driver has at his command by a single movement an opportunity to obtain either power or speed. On this car the lever thrown to the left will give the driver a speed of only four miles per hour, but great power for use on hills, pulling out cars, etc. Throwing it to the right a speed of 16 miles per hour is obtained. Different speeds can be had for different roads by a change of gears on the armature shaft, etc. This car was run experimentally on the Amesbury & Merrimac electric road for several months, and fully met the expectations of its inventor. It was several times called upon to pull the regular cars on the track, which was done with the power gear without using more than one-quarter of the current. At one time the regular car being partially disabled was unable to climb the hill six miles from the power station, and called upon this car to push it up, which it did with its load, starting on the hill.

The car is now running on the Amesbury end of the Black Rocks & Salisbury Beach Street Railway, a mile and a half of which has several very heavy grades, one of which is 11 per cent., another one of over nine per cent., with a sharp curve. This is a beach road, and on holidays carries crowded cars, requiring a tow car on many trips. By the use of this power arrangement these loads are taken over the heavy grades with apparent ease.

FIG. 2.—THE GOSS ELECTRIC RAILWAY MOTOR AND TRUCK.

The Incandescent Lamp Industry in France.

The French Chamber of Deputies has recently been suffering from a severe attack of "protection fever." Not the least clamorous for prohibitive duties was the electrical industry, which has not prospered in France in the way true patriots would like to see. Heavy duties have been imposed upon everything electrical except instruments of precision, which are allowed in free of duty out of respect to pure science. Among other duties imposed is the curious one of 500 francs per 100 kilogrammes of incandescent lamps. French lamp makers are of opinion that this tax, while not acting as a prohibitant, will probably operate as an irritant upon foreign and most especially German lamp makers. Either owing to internal or external competition, the price of incandescent lamps in France is considerably lower than it is in England, since a 100-volt 16 c. p. lamp taking four watts per candle and lasting 1,000 hours can be had for the sum of about two shillings, the ruling price in England being between four and five shillings. Hence it would seem necessary to impose a considerably higher tax than that of 500 francs per 100 kilogrammes, which comes out at about 1-5 pence per lamp, if lamp manufacturers in France are to reap the profits which are now flowing into the coffers of the Edison-Swan company in England. Consumers are beginning to clamor for lamps taking three watts per candle and 500 hours life.

A Course of Electrical Reading.*

BY DR. LOUIS BELL.

Special courses of electrical reading may be laid out to suit the requirements of almost any particular case, but the well-informed electrician will, as a rule, desire to make his reading comprehensive, and not omit any of the well-known branches of electrical science. A convenient way of

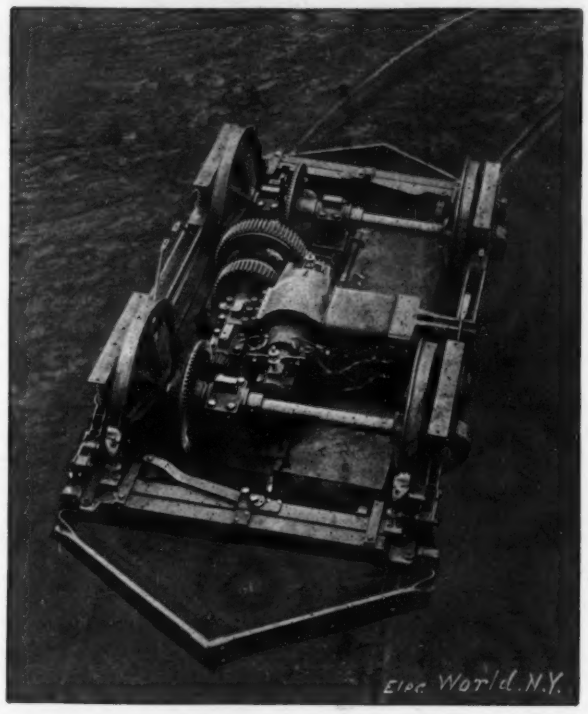


FIG. 1.—THE GOSS ELECTRIC RAILWAY MOTOR AND TRUCK.

dividing applied electricity for our purpose is somewhat as follows:

Electric lighting.
Electrical transmission of power.
Electro-metallurgy.
Electrical testing.
Telephone.
Telegraph.

There are comparatively few satisfactory treatises on electric lighting in general; they are usually too popular in their character to give much valuable information to the specialist. Two of the most available general works are those of Aglave and Boulard, and Urquhart; both have for their subject the electric light. The former gives an excellent historical résumé of the earlier stages of the art, while the latter is somewhat more practical and modern. The great treatise of Dredge on "Electric Illumination" is a splendid book of reference, but is unfortunately scarce, the first volume being particularly hard to obtain. I cannot well pass by here the very excellent recent book on "Decorative Electricity," by Mrs. J. E. H. Gordon, which is really the only work now extant on the art of domestic illumination by electricity, and which, moreover, is very interesting reading. Of practical manuals on special departments of electric lighting there are quite a number, some of them of great merit, but most of them are too general in their treatment of the subject to be of much use to the practical man. Of arc lighting there is no more efficient treatment than that which may be found in Desmond's little work on "Electricity for Engineers." This is full of intensely practical directions to those actually engaged in the operation of plants. Incandescent lighting is hardly as well off in the matter of literature. The most convenient work at present is a tiny volume by Latimer, Field and Howell on "Incandescent Electric Lighting"; it refers chiefly to the Edison system, but as this is typical of other direct-current incandescent systems it is equally available, whatever type of dynamo is to be used. On the dynamo and its construction in general the two books previously mentioned by Prof. S. P. Thompson and Carl Hering are the best suited to the general needs of the reader. Alternating current installations are very unsatisfactorily treated in any of the books now within reach of electricians. The theory of the alternating current dynamo, the transformer and methods of distribution, is admirably given in Fleming's "The Alternate Current Transformer in Theory and Practice," vol. I., and problems in distribution are given in Blakesley's "Alternating Currents of Electricity." Both these works, however, are better adapted for the student and the scientific electrician than for the needs of the practical man, as the mathematics involved are somewhat formidable to the general reader, and alternating current practice is given a comparatively small place. The second volume of Fleming's work, now in preparation, will place in the hands of the electrician a most admirable work on the details of our present systems of alternating current machinery, and it is to be hoped that it will soon be pushed through to completion. Before leaving the subject of electric lighting one good book on wiring deserves to be mentioned. There are a large number of wiring handbooks of a greater or less degree of merit, but by far the most useful one I have yet seen is Carl Hering's "Universal Wire Computer," inasmuch as it is simple, quite complete and very easy to work from. The best way to learn about the details of electric lighting is by personal examination of central stations and such experience as it is found possible to obtain. A great deal that is of really immense importance does not find its way into the books at all.

With respect to electrical power as a separate subject there is very little that is valuable in the way of literature; the two books on electric motors by Kapp, and Martin and Wetzler, previously mentioned, are the best now available, and the former is almost the only elaborate discussion of power distribution as separate from lighting. There is now no practical treatise on the electric railway, important as this department of the subject is, although a book on that subject by the writer in conjunction with Mr. O. T. Crosby is nearing completion. It is best to place reliance on Kapp for the present; nearly all that applies to distribution of electricity for electric lighting is equally true of its distribution for power, but in both cases the best teacher is observation.

Electro-metallurgy has received admirable treatment at the hands of several very well-known electricians, and any one wishing to acquaint himself with its theoretical and practical sides can do so with comparative readiness. A convenient elementary book is Gore's "Theory and Practice of Electro-Deposition," but perhaps the best complete discussion of the subject is to be found in Watt's "Electro-Deposition," which is really a very elaborate discussion of all the details of the subject, electro-metallurgy proper, electroplating, electrotyping and almost every ramification of the subject. Another very practical and satisfactory work is Dr. William H. Wahl's "Galvanoplastic Manipulations," dealing specially with the methods employed in actual practice and the precautions that must be taken. Electro-metallurgy proper—that is, the electrolytic separation of metals from compounds—rather than electrotyping and similar topics, is to be found in Gore's "The Art of Electrolytic Separation of Metals," perhaps the only special treatise on that topic. Electrotyping as an art by itself may be found very well discussed in Urquhart's book on the subject. This general department of applied electricity is one upon which it is quite easy to obtain pretty complete information, for the art has been thoroughly worked out and the practice does not change by any means so greatly or so rapidly as in other branches of electrical science.

Concerning electrical testing I have already spoken in recommending the second volume of Stewart and Gee's "Practical Physics" and Ayrton's "Practical Electricity." These are well-known laboratory handbooks; for more refined work there is nothing better than Gray's "Absolute

* Continued from THE ELECTRICAL WORLD, Aug. 8, 1891.

Measurements in Electricity and Magnetism," a comparatively small volume, but one full of instruction in the refinements of scientific measurements. His large work on the same topic, of which the first volume only is issued, is even more elaborate in its discussion of minutiæ and the theory of the methods employed. One of these books is quite indispensable to the scientific student. The second volume of Mascart and Joubert is worthy also of very frequent consultation. Kempe's "Handbook of Electrical Testing" is also a valuable work for reference; it is confined mainly to practical methods of laboratory manipulation in the use of measuring instruments and to the details of telegraph and cable testing of the most refined sort. One really learns, however, very little about the art of electrical testing from books, and those mentioned should be regarded rather as works of reference. Practical experience in the laboratory is invaluable in attaining anything like efficiency in making tests; and a little experience will teach a great many short cuts and convenient methods of approximation that are necessary in every-day work.

The telephone is the subject of a considerable number of treatises, both practical and theoretical. Perhaps the most recent and extended of them is Preece and Maier's work: it is by far the most satisfactory as a book of reference and instruction, and will well repay careful reading. Another exceedingly useful, practical handbook for those who are in every-day telephone work is Lockwood's "Practical Information for Telephonists." These two volumes cover the practice of telephony as completely as it is likely to be covered in books, at least for the present. For one who wishes to obtain a great deal of popular information as to the progress of the telephone since its invention, manifold descriptions of instruments, and in general a popular rather than a practical treatment of the subject one might recommend Prescott on "Bell's Electric Speaking Telephone," which is quite readable, like Prescott's other works, and fills a useful sphere in giving an extensive collection of facts not otherwise easily gathered together.

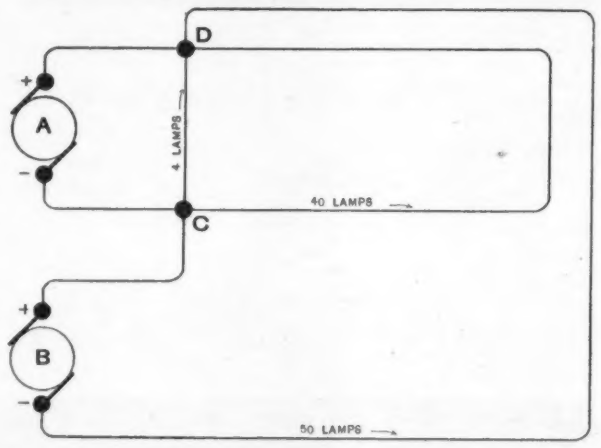
Telegraphy is best learned by actual experience, but there are some works well worth reading, and which may prove of considerable use. One interesting volume that well rewards one for the time spent in reading it is Fahie's "History of Telegraphy." It stops with the introduction of the telegraph systems that have undergone gradual development since the time of Morse, but is filled with interesting information concerning the earlier attempts at the telegraph and the history of the experiments that led up to the present development of the art. Of more practical treatises perhaps the most satisfactory are Lockwood's "Electricity and Magnetism and Electric Telegraphy" and Preece and Sivewright's "Telegraphy." Both of these books are practical and to the point, and will be found serviceable to the student. The quadruplex telegraph and the applications of the dynamo to telegraphy may be best learned from Maver and Davis' small volume on "The Quadruplex." Aside from these special treatises there are a few useful books of a miscellaneous character that may be recommended for reading and study. First among these is S. P. Thompson's "The Electromagnet," which deserves special mention as being the only scientific treatment of the construction of electromagnets; it is a very recent book founded on modern ideas and invaluable to the electrician in the designing of electromagnets for various purposes. On primary batteries there are a number of books of more or less merit, the most recent being Prof. Carhart's work. The storage battery is a subject on which it is not easy to obtain practical information; altogether the best of the works that treat it is Reynier's "The Voltaic Accumulator," which gives quite a complete account of the various secondary batteries that have been used and experimented with up to date. As regards the practical management of the storage battery a useful book is that of Sir David Salomons, entitled "Electric Light Installation and the Management of Accumulators;" it is not altogether satisfactory, as it relates principally to a single type of storage battery, but it is the best work available, and is worth reading by those who desire an acquaintance with the practical side of the subject.

The special topic of electric bells and their arrangement in practice is treated by Allsop in a little volume on "Practical Electric Bell Fitting," a book that will be of use only to a comparatively limited class, but which is very convenient in its way. For further information the only course open is to study the periodical literature of the past few years.

I may well close these few notes of electrical reading by mentioning one or two books on electrical constants and data in general. Mascart and Joubert's "Pocket Book," previously noted, is one of the most convenient of the number, and for those who wish information on subjects outside of electricity as well Everett's "Physical Constants" is perhaps the best work in English. In making out this list I have purposely omitted the numerous French and German works that have been published from time to time for the reason that most electricians have not the command of either of these languages; the thorough student of electricity is likely to know one or the other of them and indeed should do so. The most important book in either of these tongues is Wiedermann's great treatise on electricity, and it will prove very valuable as a book of reference to those who are fortunately able to read it. The French have produced a number of important works for the student, perhaps the best of them being the one by Mascart and Joubert, which has been translated into English. The most important of the French electrical journals is *La Lumière Electrique* and the corresponding German paper the *Elektrotechnische Zeitschrift*. In concluding I can only strive to impress on the electrician the importance of studying the subject in which he is interested as carefully as possible from books, and then backing up the knowledge thus acquired by actual experience. Books are immensely convenient, and contain, so to speak, the crystallized part of the science of electricity; they cannot, however, keep up with the changes that are taking place, and for a proper knowledge of what is going on persistent reading in the electrical journals is an absolute necessity, for before a collected volume can be written and go through the press the art of the applications of electricity will have undergone improvements, and the science will have been enriched by valuable researches.

A Problem in Cross Circuits.

A few weeks ago a correspondent sent to us the following problem suggesting that it might interest some of the boys to exercise their wits on it. Here it is: Two arc light circuits arranged as shown in the figure; the dynamo *A* operates 40 lights, the dynamo *B* 54; the second circuit falls across the first inside of its load of 40 lamps; of the second circuit 50 are outside the cross and four in the line between *C* and *D* across the first circuit. The polarity of the dynamos is as shown; they are Brush machines of the ordinary type; 50 volts per lamp is required, and the normal current in each circuit is 10 ampères. What happens? What is the distribution of the current? What will the dynamo do, and, finally, what happens to the four lamps in a direct line between *C* and *D*? We shall be glad to hear from our arc



A Problem in Cross Circuits.

lighting friends their various solutions of a problem that resulted from an actual occurrence under the conditions named.

The Edison Lamp Decision and Its Results.

BY WILLIAM ZIMMERMAN.

Since the time of the decision of the Bell telephone suits by the Supreme Court of the United States there has been no patent case which aroused such a general interest and so many adverse comments as the recent decision of Judge Wallace in the Edison lamp suit.

This adverse criticism comes, in a large measure, from parties who are either directly or indirectly interested in patents, and who now complain because the hand of justice smites them.

Like Bell, Edison accomplished what many before had tried and failed to bring to a *practical* success. Other experimenters had tried carbon filaments, and one here and another there had really, in single parts, produced every mechanical feature of the Edison lamp, each trying, and each in turn failing, to attain the desired end, and acknowledging the difficulty of the undertaking. Success seemed yet far off, if at all attainable, and the fact was therefore not readily accepted when Edison's enthusiastic friends cried "Eureka!" They wanted the proof; but when the proof demonstrated that the invention would really become a commercial success, the doubters became the enthusiastic acceptors of the accomplished feat, because it proved to be profitable, and then when accused of appropriating the right which belonged to the real inventor, they became equally earnest to show that he had never made any invention.

It is a matter of no slight interest in view of the well considered opinion of the learned judge, founded on the facts disclosed, to see the singularly adverse criticisms of parties who are interested in inventions and the laws which govern them. It is only necessary to ask what would their opinions have been if they had been on the other side of the question?

If patent property depended on the opinion of these adverse, though interested critics, what would it be worth? What encouragement would they give to themselves as inventors, if after years of toil and self-imposed expense their right could be overthrown by proving that A had long before made a carbon filament; that B had made it incandescent; that C had put it into a glass globe; that D had formed a vacuum in the glass globe; that E had fused the leading wires into it; that F had proved that high resistance was indispensable, and so on to the end of the matter?

These critics have overlooked the fact that the claims are not for any one, or several, but for all those elements combined and operating together as a unit as claimed, viz.: "The combination of a carbon filament with a receiver made entirely of glass and conductors passing through the glass and from which receiver the air is exhausted;" that it would not be possible to obtain a valid patent for any single element unless *that* by itself happened to be new, and that then it could not, at the same time, serve as a patent for a glow lamp.

This opinion ought rather to be a matter of general gratification to all, irrespective of their interests, because the law is thus becoming more and more settled that personal rights shall be respected in inventions as well as other property. This renewed security thus assured to the inventors and manufacturers will stimulate to renewed efforts which will more readily find needed capital for worthy inventions, of which the ultimate result will be a cheapening to the consumer of the productions of the inventor, increased luxuries and a greater stride in the onward march of progress.

Under the stimulating influence which inventors have already received through patent protection, it does not at all appear likely, when we consider known facts, that the Edison lamp will be the only pioneer, but that the near future will, through such encouragement, produce other new, original and superior electric lights.

When these storms of passion and selfishness shall have subsided, the decision of Judge Wallace will be accepted as the best that could have been given on the facts presented, as in the telephone cases, though that decision came from a divided court, not, however, on the question of *originality* but on this, "Was Bell or Drawbaugh the *first* inventor?" due to the number and character of Drawbaugh's witnesses apparently, but not actually, ignored by the court. They were weighed with the fact that the success and fame of Bell's telephone had made more than a *national* reputation before anybody beyond Eberly's Mills had even heard of Drawbaugh's invention. Then Drawbaugh began to think that he was the real inventor, while for years before, and even after he had seen Bell's telephone at the Centennial, he had been silent.

An acoustic telephone might, in fact, have been all that Drawbaugh had shown his unsuspicious neighbors before he saw Bell's device. But, under the general excitement of the country over Bell's telephone it became a comparatively easy matter to make them believe that they had actually seen and used a magneto-electric telephone. Pride of the man, place, and reflected glory, all stimulated by the more excitable, enlivened their minds to abnormal activity from which grew statements which had scarcely a foundation in fact, and which that inventor clearly showed by his own contradictory statements that he could and did help to originate.

Time has already shown that that decision of the majority of the Supreme Court was the best, and that Judge Wallace's single opinion, when Drawbaugh's case was before him, was not alone sustained, but that it also added its weight to that of the majority of the Supreme Court. Courts can no more administer perfect justice than they can get perfect truth; both can only be had approximately; perfection is unattainable.

Under the facts set forth the keenly discriminating and well considered opinion of Judge Wallace given in the Edison lamp suit will be very likely to receive the same consideration that his opinion received by the Supreme Court in the Drawbaugh telephone suit when this case is brought before the Court of Appeals.

Trial of the Gordon Electric Car.*

At Messrs. Merryweathers' works, Greenwich, on Tuesday, we had the pleasure of witnessing a trial run of the Gordon closed conduit electric railway. As it is not improbable that a long section of tramway may be shortly fitted up with this system, it may be worth while drawing the attention of tramway and electrical engineers somewhat forcibly to this system, a paper about which was read by Mr. Gordon himself at the Tramways Institute meeting last week, reproduced elsewhere. A line of tram rails exists at the back of Messrs. Merryweathers' works, and this line has been fitted up by Mr. Gordon as an experimental line. A car trolley completely fitted with motor gears and switching apparatus is in actual working order, and seems to behave admirably. The principle adopted by Mr. Gordon is ingenious, and the working out of it not less so. The conduit carrying the current for the motor is a very small one, some two inches or three inches of ground being quite sufficient to contain it. The supply rail is laid midway between the two line rails, and consists simply of flat iron laid in concrete in lengths of about eight feet, or one-third the length of the car. The system arranges for charging these sections by the full current of, say, 400 volts, as the car progresses, so that no section is charged except those under the car. This is done by a system of connections laid in a gas pipe with tee pieces connecting to each length and leading back to a commutating box, which is the feature of the system. These boxes are placed every 100 yards under the curb, and contain strong long-pull mag-

*From the *Electrical Engineer*, (London).

nets, one for each section. As the car progresses, a shunt current comes back from section No. 1 to magnet No. 2, which rises and puts section No. 2 into connection, cutting off No. 1, and so on, as the car moves—the main, of course, running the entire length of the road. These boxes are of very strong construction, and, as seen on the trial, act with precision and force, being able to withstand rough usage. The current being turned on, the car moved forward at considerable speed, and it is interesting to watch magnet after magnet rise and fall, like the keys of a piano, one after the other with absolute precision and not the least sparking. The pull of the magnet is about seven pounds, and evidently is more than ample to do its work. The car was run backward and forward by Mr. Gordon, under complete control, nothing more being required than the movement of the car switch, which acts both as resistance and as reverser. The advantages of the system are the use of the closed conduit—no slot or wires that can be touched being needed, the small cost of conduit, and corresponding small cost of alteration of track. Not the least effective advantage of the Gordon system is that by the addition of one contact the absolute metallic return for the current can be made by way of the section behind, and thus the difficulty with the telephone companies can be avoided—a matter impossible of arrangement with most systems without costly additions to the mains.

The cost of alteration of track and laying the electric conduit is estimated (the figures being checked by Messrs. Merryweathers' engineer) as £2,000 per mile, of which £25 each is the cost of commutator boxes. The cost of a new electric car would be £400. Mr. Gordon, allowing all possible contingencies, estimates the actual cost of traction at 2½d. per car mile. As to the commutator boxes, our opinion is that these will do their work, and that they are not in the least more fragile than the commutator bars themselves of the dynamo.

The German Emperor's Palace.

It will not be without interest at this juncture to read the details of the electric installation at the Royal Palace at Berlin. Hitherto the illumination has been by candles, no gas having been admitted. The whole has recently been fitted with electric light. The plant consists of two engines of 150 h. p. and 50 h. p. Space is arranged for two others of 200 h. p. each. There are two dynamos—a four-pole machine driven by the smaller engine, and a six-pole machine of 100,000 watts, coupled to the 150 h. p. engine. When finished the present total capacity will be 360,000 watts, with a battery of 860 ampère hours' capacity. In the Imperial chambers there are 557 lamps of 10 c. p. to 25 c. p. The corridors contain 152 incandescent lamps, and offices 133 lamps. The gateways have nine arc lamps of six ampères. The ball rooms and drawing rooms have in all 1,960 incandescent lamps, of which over 1,000 are in the great White room.

Destruction of the Staten Island Plant.

On Monday night, Aug. 3, the central station of the Richmond Light, Heat and Power Company, at St. George, S. I., was totally destroyed by fire. It is one of the few serious disasters that have befallen any electrical installation during the present year. The Richmond station was fully illustrated in the issue of THE ELECTRICAL WORLD of Dec. 6, 1890. It was owned largely by Erastus Wiman, and his son, Mr. W. Dwight Wiman, was its general manager. The dynamos in the station were 12 in number, two of them being small Edison machines used to excite the Westinghouse alternators. There were four engines, three of them being Armington & Sims machines of 65 h. p. each, and the other a 500 h. p. Hamilton-Corliss engine, which drove the bulk of the machinery. Two of the three small engines were used for the arc light service, one being belted to a Thomson-Houston, and one to a Wood arc dynamo; the third was directly belted to a 750-light Westinghouse alternator. The other five alternators, three 750-lighters, one 1,500-lighter and one 1,300-lighter, all of Westinghouse make, and two exciting dynamos, were driven from a line shaft by the Corliss engine. The boilers were six in number, situated in a building adjacent to the dynamo room. Three were 75 h. p. tubular boilers, two Abendroth & Root boilers of 150 h. p. each, and one 350 h. p. marine boiler. The company has been in operation about four years and had established a very successful business amounting to 600 incandescent and 175 arc lamps. The fire was discovered about half past eight o'clock Monday evening, when flames began to creep out from under the eaves of the boiler house. The company's hose attached to the fire plugs was immediately got ready for action, but the Staten Island Water Supply Company was not carrying pressure enough to enable the hose to be used. The local fire department was at once called out, but by the time it arrived the flames had gathered too great headway to be suppressed. Soon the boiler room had to be abandoned. Mr. E. S. Terhune, the electrician, and the engineers, stuck to the dynamo room until it was useless to attempt anything further, when the big engine was shut down, the switches drawn and the plant abandoned. Mr. Wiman arrived in time to save everything of value in the office, but nothing more could be done except to watch the fire.

Just how the fire started is unknown, but appearances indicate that it was caused by some defect in the smoke flues. Our cut, from a photograph the day after the fire, shows only too plainly the destruction that was wrought. The temporary installation, which is to supply the place of the burned station, is already well along. Part of the ruin has been cleared away and a house erected for the dynamos and engines. Three alternators, a 2,000-light Westinghouse, a 2,000-light Fort Wayne and a 1,300-light Thomson-Houston, are now in place belted to three high-speed engines, two of them of the Ball make and the other a Wood. The arrangements are not yet completed, but everything will be ready and the incandescent lights will be turned on Saturday, August 15. This shows very commendable enterprise on the part of the manager, and at this rate it will not be long before a station larger and better than the one destroyed will be in operation.

GENERAL VIEW OF THE STATEN ISLAND LIGHTING PLANT AFTER THE RECENT FIRE.

Franklin's Kite Experiment.*

BY ALEXANDER M'ADIE, M. A.

Picture to yourself, if you will, an infinite ocean of jelly, in which in various parts a liquid is entrapped and entangled. This liquid will remain fast bound there until the walls of the jelly which imprison it in some way yield or are ruptured. This will give you, as one of the great physicists of our day suggests in his "Modern Views of Electricity," a fair model of the general insulating atmosphere. Made up, as it is, of a mechanical (not chemical) mixture of oxygen, nitrogen, water vapor, traces of carbonic acid, carbureted and sulphureted hydrogen gases, ammonia, nitric acid and (though last, by no means least) dust, our atmosphere will stand for the jelly,—an infinite ocean of it,—and the entrapped liquid, the electrification (or electricity, if you will), which we find on the rubbed surfaces of glass, resin, etc., or in a natural way upon the surfaces of the little vesicles which in the aggregate make up a cloud. While the jelly walls hold, the entrapped fluid is like gas in an entrapped gas well. That is, while the air completely surrounds the body on which an electrical charge resides, the charge will remain there, fast bound. Let this air become very damp or filled with dust, or both, and it is analogous to having the jelly become itself very much of a liquid and its restraining power, therefore, small; but let the general atmosphere be fairly pure and dry, and there is not much difficulty in "storing" your electricity.

What we will want to particularly consider, in any investigation of the electricity of the air, is the "dielectric strength" of the air; or, in the familiar language of our analogy, the pressure which the ethereal jelly can withstand before the liquid breaks down the confining walls and escapes with a greater or less degree of violence. This is what we are now attempting to do, viz., get at the electric stress in

* From the *American Meteorological Journal.*

the air, and it may not be long before we will be able to determine by measurement whether or not a thunder cloud overhead has an electrification sufficiently strong to break through the air barrier between it and us, and whether we shall have lightning from that cloud, or whether, pushed and drawn by the winds, that cloud mass with its charge will harmlessly pass by, seeking elsewhere opportunity and place to discharge or lose its electrical energy.

Date.	Name.	Experiments.	References.
1752	Kinnersley, Boston.	Observations on the electrification of the air.	"Franklin's Letters," *Phil. Trans.*, 1763, 1773.
1752	LeMonnier, Paris...	Observations on the electrification of the air.	"Mem de Paris," 1752.
1752	De Romas, Paris....	Observations on the electrification of the air.	"Mem. Sav. Etrange," II.,1755
1752	Abbe Mazeas, Paris	Kite experiment, independently of Franklin.	*Phil. Trans.*, 1753.
1752	Abbe de Nollet, Paris.....	Speculations on the theory of electricity.	"Recher. sur les causes," etc. Paris, 1749-54. "Recueil des lettres, etc.," Paris, 1753. "Lettres sur l'elec.," Paris, 1774.
1752	Watson, London....	Experiments on electrification of clouds and protection from lightning.	*Phil. Trans.*, 1751, 1752.
1753	Richman, St. Petersburg.....	Electrical gnomon. Killed by lightning, Aug. 6, 1753.	*Phil. Trans.*, 1753.
1753	Canton, London ...	Observations of the electrification of clouds.	"Franklin's Letters,"and *Phil. Trans.*, 1753.
	Collinson, London..	Franklin's correspondent who introduced F's experiments to the notice of the Royal Society.	
1753	Pere G. B. Becaria, Turn	Systematic observations with an electroscope.	"Lettere del Elettric," Bolognа, 1758.
1754	D'Alebard, Paris...	Experiments and observations during thunderstorms	*Mem. l'Acad. des Sciences*, May, 1762. "Hist. abregu d'ebe," 1776.
1769	Cotte, Paris.....	Memoirs on Meteorology.	"Mem. Paris." 1769-72. *Journ. Phys.*, XXIII., 1783.
1772	Ronayne, London...	Observations with regard to fog and mist.	*Phil. Trans.*, 1772.
1772	Henley, London....	Observations and quadrant electrometer.	*Phil. Trans.*, 1772.
1775	Cavallo, near London	Improvements in apparatus and observations on fogs, snow-clouds and rain.	"Treatise on Elec.," 1777.
1784	De Saussure.....	Improvements in apparatus and observations.	"Voyage dans les Alps."
1786-7	Abbe Mann.....	Daily observations with an electrical machine of number of revolutions required to produce a given spark —with a record of the meteorological conditions.	
1788	Volta.....	New electroscope and burning match.	"Lettere Sulla Meteor.," 1783.
	Crosse.....	Experiments with collectors.	*Gilb. Ann.*, Bd. 41 S. 60.
1791	Read.....	Improved insulation and conductors.	*Phil. Trans.*, 1791.
1792	Von Heller, Fulda..	Observations.	"Green's J. d. P.," Bd. 4.
	Schubler, Tubingen	Observations using "weather-rod" method.	*J. de Phys.*, LXXXIII.,184.

That unique genius and great philosopher who, as a militia colonel, underwent the rare experience of having his pet pieces of electrical apparatus shaken from off their shelves by the ragged and ill-timed firing of a salute in his honor by the regiment he commanded (which, by the way, was about the only service of a warlike character that regiment ever performed—it being disbanded by order of the king soon after its organization), was the first, as we all know, to bring to the attention of the scientific world the general identity of lighting with the electricity developed by the large frictional machines of that time. The famous kite experiment is described by Franklin in a letter dated Oct. 19, 1752 (Letter XII., "Franklin's Experiments on Electricity"):—"Make a small cross of light sticks of cedar, the arms so long as to reach to the four corners of a large thin silk handkerchief when extended. Tie the corners of the handkerchief to the extremities of the cross, so you have the body of a kite which, being properly accommodated with a tail, loop and string, will rise in the air like those made of paper, but, being made of silk, is better to bear the wet and wind of a thunder gust without tearing. To the top of the upright stick of the cross is to be fixed a very sharp-pointed wire rising a foot or more above the wood. To the end of the twine, next the hand, is to be tied a silk ribbon, and where the silk and twine join a key may be fastened. This kite is to be raised when a thunder gust appears to be coming on, and the person who holds the string must stand within a door or window, or under some cover, so that the silk ribbon may not be wet, and care must be taken that the twine does not touch the frame of the door or window. As soon as the thunder clouds come over the kite the pointed wire will draw the electric fire from them, and the kite with all the twine will be electrified, and the loose filaments of the twine will stand out every way and be attracted by an approaching finger. And when the rain has wet the kite and twine you will find the electric fire stream out plentifully from the key on the approach of your knuckle."

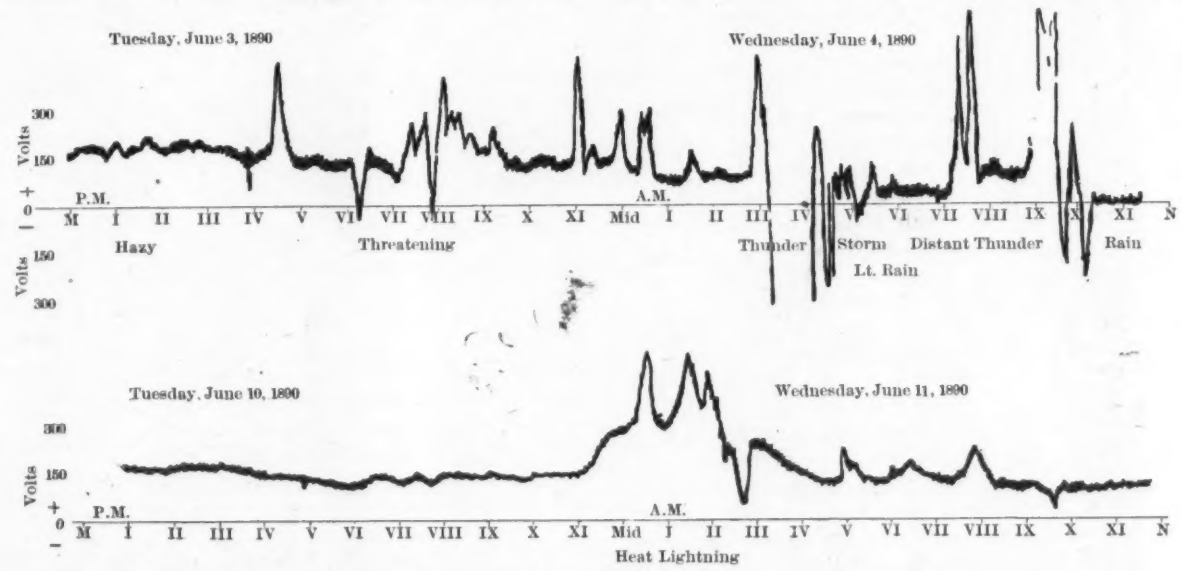
There is a certain audacity shown in this experiment which fascinates, and undoubtedly has a good deal to do with the deep interest which this experiment excited when first announced, and still excites. It was audacious. The fate of Richman was like a clap of retributive justice. We may not go into the details of that accident. The rough diagram of the room in which the St. Petersburg experimenter was killed was published in that year, 1753, in the *Philosophical Transactions*. And supposing that we did not know from direct evidence that it was lightning that killed Richman, an expert of to-day, noticing the escape of a companion, standing at the time within three feet of the victim, would recognize by this and the peculiar "tearing-off" and "throwing" effects, the existence of an electrical current of exceedingly high potential, small ampérage and oscillatory in character. In order to have before us at a glance the experimentation of the fifty years following Franklin's work, I have made this brief table of the chief experimenters and their results:

We repeated Franklin's kite experiment, 133 years after its first trial, at the Blue Hill Observatory, some ten miles out from Boston. The summit of the hill has an elevation of 635 feet above sea level, and is therefore the highest point on that section of the Atlantic seaboard. With the exception of two or three neighboring hills, all the surrounding country is low and level. The average elevation is under 100 feet, and on all sides this low land is well watered, having many ponds and small rivers. An exact statement of the apparatus used may be found in a paper in the *Proceedings of the American Academy of Arts and Sciences*, and it will be enough here to say that we used a multiple quadrant electrometer, a portable dry battery of 100 Beetz cells, set up in series, a newly set-up Daniell cell, two large kites, silk-covered and tin-foiled on the front face; 1,500 feet of strong hemp fish-line, around which in a close spiral was wound No. 22 uncovered copper wire; some insulating materials, an electrometer commutator, binding screws, a condenser, etc. After all, about the only advance which we made on Franklin's experiment was in this, that at every step of our experiment our electrometer enabled us to measure, in terms that can always be referred to, the electrical potential of the atmosphere. Thus, for example, we first found the difference between the potential of the ground and the potential of the air, at a point about two feet from the observatory walls and five feet above the ground. For this purpose we used the insulated water-dropper method devised by Sir William Thomson. The potential of the air at such a point, as we shall see, is almost that of the ground. With the kite 200 feet high, the aluminium pointer of the electrometer, when thrown into connection with the kite-string, was deflected with a considerable impulse, beyond the limit of the scale (over 500 volts), or in other words, indicated an electrification of the air at that point as high as 500 Daniell cells set up in series would give. Franklin put his knuckle to the brass key and got a slight shock and a small spark. We got the same, and when our kite was 1,000 feet high, we got sparks which we measured and found to be over ½ inch in length. We had our kite up on several days, and for as many as twelve hours at a time; and on one perfectly cloudless lovely summer afternoon we got our first sparks from a perfectly *cloudless* sky. Aside from the scientific measurements of the potential of the air, which we were after, we found that one sitting within the "instrument-room" of the observatory, with his back to the windows, and watching only the movements of the electrometer needle could say *positively*, as quickly as an observer outside watching the kite, whether the kite was rising or falling. A rise in the position of the kite, even when a thousand feet high, was shown instantaneously by the increased voltage, and *vice versa*.

Now, to make some practical use of the knowledge thus gained, that as we ascend in the atmosphere the electrical potential of the air increases, we must have first some proper notion of what the rate of increase is; what, at a given elevation, the potential may be estimated at, if our purpose be to utilize this natural electrification in the service of man, or as they proudly said in by-gone days, "to harness up the electricity of the heavens," unaware that the electricity of the heavens is always at work in the service of man, and that every flash of lightning is visible evidence of the expenditure of a certain amount of the accumulated energy of the atmosphere, in clarifying and re-invigorating the air for man's and nature's breathing. We have a common classroom experiment of filling a half gallon fruit jar with smoke, and let it stand a while to show that there is but little settling of the smoke particles. The cover of the jar is made of hard rubber, through which runs two binding screws and terminals. We pass a spark inside the jar from one terminal to the other. Instantly the smoke settles, the atmosphere of the jar is cleared, the smoke particles are driven with some force to the bottom and sides of the jar—and not one or two, but frequent washings are necessary to remove the smoke odor. Our atmosphere is not a dust jar exactly, but every once and awhile it badly needs to have the dust and impurities in it settled, shaken out of it, and this is *exactly what a lightning flash does*. And a very important work it is.

Some two or three years ago some further experiments were made under the direction of the Chief Signal Officer at the top of the Washington Monument, Washington, D. C., which was at that time the highest edifice in the world. We were 500 feet above the city streets. Instead of the kite, we used a water-dropper collector. We will take one July afternoon. Looking out of the west window, about 2:45 P. M., far beyond Arlington and the Virginian hills to the west and southwest, the eye saw a pallium of dark cumulo-stratus cloud creeping onward to the banks of the Potomac. The storm was possibly 25 miles away. It needed little experience to foretell a thunder squall. In five minutes you can hear the rumble of the thunder; by 3:15 P. M. the storm is overhead, and the lightnings are fast and vivid around the monument. Every window save the one through which the nozzle of the collector projects is closed, and the heavy marble slabs bolted, for the fury of the wind at that height and time would have driven us from our place. But what has the electrometer needle been doing all this time? Quiet? No! From the very beginning, flying from one high value to another! Three thousand volts! and the sparks are crackling thick and fast between the fine wire we use for the suspension of our needle, and the neck of the brass top plate of the electrometer, the nearest metal to it. With all our experience and care, the harness will not hold the steed. We measured frequently as high as 3,000 volts. The sparks were popping merrily away at a rate of 10 or 15 per second. There were two intense flashes about 3:10 P. M., so remarkable as to excite comment at the time. What effect had they on us? It is an old truth that whoever seeks to pry into natural secrets, will find Nature herself willing to meet him half-way. We saw it first with these flashes, and afterward found it to be true with every flash, that we could use our stream of water as a timepiece to *tell us when a flash of lightning was going to occur!* Previous to a flash, the stream under the influence of the increasing electrification twists and splits into threads and spray, until the very instant that the flash occurs, when it resumes its even, rounded, normal character. It is very much as if our jelly wall or air barrier was pulled at each end, or, to make a still easier analogy, as if the air between the earth and the thunder cloud were a rope with the cloud electrification pulling it toward itself, and the induced earth charge pulling its way. Now, then, the individual fibres in the rope, as the pull increases, begin to stand out at right angles to the rope itself. Our insulated water stream, flowing from the nozzle of our collector, is an individual fibre in the rope, and can be made to give us warning of how great the electric pull is. We suggest this to all photographers who wish to know just when to expose to catch photographically the lightning flash. When the air rope breaks the flash occurs.

As the stream of water showed itself so very sensitive to the electrification of the cloud, we were led to wonder



A STUDY OF ATMOSPHERIC ELECTRICITY AT CLARK UNIVERSITY, WORCESTER, MASS.

whether or not the charge of the thunder cloud could be so effective as to facilitate evaporation by actually pulling the water in minute drops from the stream. The following experiment seems to prove conclusively that a thunder cloud can bring about an accumulation of water and dust particles upon itself. In place of a charged cloud, we took a highly polished brass plate, well insulated, and raised to a very high potential. Bringing it near the fine stream of water, and holding it some four or five inches away, and above the stream, we find at once a deposit upon it of minute drops of water. These have been actually torn from the stream, and against gravity, too.

It is now known that steam jets, as well as water jets, respond to electrification. Lord Rayleigh found it possible to close up a straggling jet; Robert Helmholtz electrified steam jets and found it possible to get diffraction colors varying with the potential, and finally Shelford Bidwell, but a year or so ago, showed both the change in color of a steam jet with electrification and the increase in the size of the water particles, and thereby the possible explanation of the orange and reddish yellow tints of the thunder cloud.

Thunder storms are, of course, the most imposing and sensational, if the word may be allowed, of the manifestations of the electrical energy of the atmosphere. But it is in the steadily continued, quiet, systematic observations of the potential that the scientist finds his field. Lightning is the show member of the group, but the auroral crown, band, streamer, dust or haze, or the St. Elmo fire, the gentle brush discharge that we find on Pike's Peak, or any high mountain, under certain meteorological conditions, is equally important. To know that we can get sparks from a sky perfectly cloudless, or that the potential of the air increases as we ascend, or that the potential gradient at a given height is determined by barometric pressure, humidity and other meteorological factors, these and many more crown the less showy work of constant observation. In the Kew Observatory, at the Parc St. Maur at Lyons, and Perpignan this work goes on, seemingly of no importance to the business world. And yet it is the unexploited work of the man of science, studying year in and year out questions of solar physics, that determines to-day the ownership of land and the safety of commerce. It tells us how much the north point of the surveyor's compass changes from day to day, from year to year. Likewise, only by continuous and patient observation shall we get that knowledge, enabling us to have not only reliable bulletins of the weather, but what we may expect our bodily sufferings or enjoyments for the day to be, in so far as the weather affects these. For years many of the medical profession have wished for these curves—the continuous records of the potential of the atmosphere in their vicinity—for comparison with their statistics of certain nervous complaints, mental depression, hysteria, etc., etc. The horrible feelings of depression which many experience just in advance of a thunder storm and the great relief after the passage of the storm, if it were only possible to plot, might show perhaps a surprising correspondence with the curve of the potential changes.

Two curves obtained by photographic registers are here given to illustrate the potential conditions for two days. The base line is supposed to be zero potential, or, as it is commonly put, the normal potential of the ground. Beginning with 12 M., June 3, we notice a marked disturbance about 4:45 P. M., possibly due to heavy clouds, with further disturbances after culminating in the thunder storms of the early morning of June 4. Such a day is an exceedingly trying one, especially to persons with a highly developed nervous organization. The second curve on the other hand represents the conditions of a far less trying day. The variation in potential due to heat lightning is noticeable.

The Insolubility of Pure Metals in Acids.

The results of an investigation concerning the cause of the insolubility of pure metals in acids have recently been published by Dr. Weeren. De la Rive, so long ago as the year 1830, pointed out that chemically pure zinc is almost perfectly insoluble in dilute sulphuric acid. Dr. Weeren's theory of the phenomenon is as follows: "Chemically pure zinc and also many other metals in a state of purity are insoluble or only very slightly soluble in acids, because, at the moment of their introduction into the acid, they become surrounded by an atmosphere of condensed hydrogen, which under normal circumstances effectually protects the metal from further attack on the part of the acid." The experiments from which this theory has been derived were briefly as follows. The amount of chemically pure zinc dissolved by the acid was first determined. It was next sought to determine what difference would be effected by performing the experiment *in vacuo*, when of course the escape of the hydrogen would be greatly facilitated. The solubility was found under these circumstances to be increased seven-fold. Next the experiment was performed at the boiling temperature of the dilute acid, first when ebullition was prevented by increasing the pressure, and secondly when ebullition was unhindered. In the first case, when ebullition was prevented, the solubility was practically the same as in the cold; while in the second case, with uninterrupted ebullition, the solubility was increased 24 times. Finally, experiments were made to ascertain the effect of introducing into the acid a small quantity of an oxidizing agent capable of converting the hydrogen film to water. When a little chromic acid was thus introduced the solubility was increased 175 times, and when hydrogen peroxide was employed the solubility was increased three-hundred-fold.

The New Engineering Company.

The many friends of Mr. H. Ward Leonard will be pleased to hear that he is about to enter business for himself, and has formed a corporation under the title of H. Ward Leonard & Co.; its principal office will be in this city, and its business will be general electrical engineering, special attention being paid to electric motor appliances, transmission of power, central station work, and plants in which advantages can be gained by the employment of apparatus manufactured by various companies. One feature of the business of the new company will be the supplying of expert information regarding engineering matters, the operation of plants, and the like by correspondence, at a moderate

H. Ward Leonard.

charge per annum. Before the first of September Mr. Leonard's new company will be actively engaged in business, and will probably occupy office in the Columbia Building, at 29 Broadway, this city. Mr. Leonard, whose familiar features are shown in the subjoined little portrait, is one of the very best known electrical engineers in this country, and has had a long and varied experience in all sorts of electrical work, beginning almost at the commencement of electric lighting in this country. Of late he has been devoting especial attention to the transmission of power, and his work in this line is already widely known. He will take with him into the new organization several of his co-workers in the Edison company, and will start in his venture with the very best wishes of a host of friends who have thorough confidence in his ability to succeed. May continued prosperity follow him in the independent line of work he is about to pursue! Mr. Leonard's successor in the Edison company has not yet been appointed, or decided upon, and his department, not easily handled by a single successor, is likely to be reorganized.

Electrolysis by Means of the Alternating Current.*

BY DR. GUGLIELMO MENGARINA.

INFLUENCE OF THE NUMBER OF ALTERNATIONS.

If at a certain current density an alternating current effects decomposition, it is found that, on increasing the number of alternations, the separation ceases, but commences again when the number is reduced. For every current density there is a limiting number of alternations, above which electrolysis cannot take place.

Let us denote by K the ordinate $O\,C = O\,E$ common to the two straight lines $C\,D$, $E\,F$ (Fig. 2), and by t_0 the time

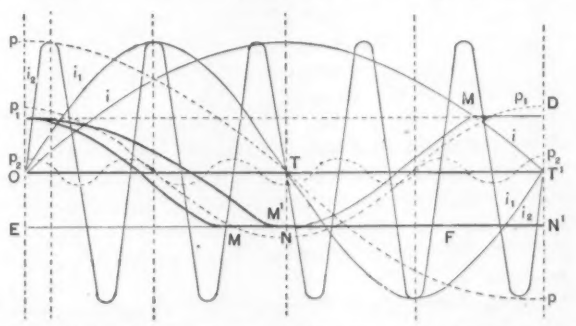


Fig. 3.—Electrolysis by Means of the Alternating Current.

occupied from O to S during which electrolysis does not take place. We observe that in the sine curve $C\,M$ to the abscissa t_0 corresponds the ordinate $O\,E = -K$, and for the curve $O\,p\,2\,T$ (Fig. 1) to the same abscissa corresponds the ordinate $-2\,K$; thus from (2) we get

$$t_0 = T\,\frac{2}{\pi}\,\sin^{-1}\left(\sqrt{\frac{K\,\pi}{P\,I\,T}}\right), \qquad (3)$$

and, therefore, the ratio between the area contained between the times t_0 and T, and that between O and T is given by the expression $1 - K\,\pi\,/\,P\,I\,T$. This shows that in a given voltameter with constant current density the ratio between the quantity of electrolyte decomposed by an alternating current and that by an equivalent continuous current diminishes as the duration of an alternation diminishes, that is, as the rapidity of alternation increases, and that there must be a limiting rapidity beyond which electrolysis cannot take place. This limit is reached when the curve $C\,M$ is tangent to the line $E\,F$, its maxima ordinate being equal to K, or in other words, when $t_0 = T$, which occurs when $T = K\pi\,/\,P\,I$.

The limiting number of alternations above which all decomposition will cease varies, therefore, in a given voltameter, with $K\,/\,P$ and inversely with I, *i. e.*, with the polarization of the voltameter and inversely with the current; and thus, by increasing the current density at the electrodes, the effect produced by an increase in the rapidity of alternation can be counteracted.

Referring to the geometrical diagram already given to show the influence of variation in current density, we will examine the effect of variation in rapidity in the same way.

The three sine curves i, i_1 i_2 (Fig. 3) correspond to the minimum, mean and maximum number of alternations which can be obtained from ordinary alternators, say from 50 to 500 per second; the abscissa $O\,T'$ representing $\frac{1}{50}$ second. The quotations to the three curves may be taken as

$$i = \sin\frac{\pi t}{20000},\quad i_1 = \sin\frac{\pi t}{10000},\quad i_2 = \sin\frac{\pi t}{2000},$$

time being expressed in millionths of a second and the maximum current passing through the voltameter being unity.

In order to draw the polarization curve resulting from equation (2) it is necessary to find the value of the constant P. If we admit with Kohlrausch that a current of unit value in electromagnetic units passing by way of platinum electrodes 1 square millimetre in area for .000000124 second will produce a polarization 1 Siemens × 1 Weber,* it follows that a current of 1 ampère decomposing water by means of platinum electrodes of one square centimetre area will give rise to a polarization of .0763 volt in 10^{-6} seconds. Thus expressing time in millionths of a second, the maximum ordinates of the three curves representing the polarization and corresponding to equation (4) will be approximately 1,000, 500, and 100, giving us the three curves p, p_1 and p_2 (Fig. 3), in which the ordinates of the polarization curves are shown to a scale of 500 times less than that used for the current curves. As may be seen from the figure the ordinates of the polarization curve increase very rapidly with the length of an alternation or inversely with the rapidity. If $C\,D$, $E\,F$ represent the limits which may be reached by polarization in the voltameter without decomposition taking place, we see that P_1 and P reach this limit, while P_2 does not, so that when $T = 10{,}000$ millionths of a second separation appears from M to N; when $T = 20{,}000$ it occurs from M' to N'.

From this figure, then, it clearly appears that with an increase in rapidity of alternation the quantity of the electrolyte decomposed decreases, and that for every current density there exists a limiting value for the rapidity of alternations, beyond which decomposition does not take place.

EFFECT PRODUCED BY A HIGH CURRENT DENSITY AT ONE OF THE ELECTRODES.

If a platinum and acidulated water voltameter is traversed by an alternating current, which, by means of an adjustable resistance, can be kept at a constant value while the surface of one of the electrodes is gradually diminished, a point is reached at which the current density at the movable electrode becomes so great that large bubbles of gas are evolved, which for a moment insulate a portion of the electrode from the liquid. The metallic surface is then capable of igniting the bubbles of gas, producing small explosions and flashes of light in the liquid. With care it is possible to render the electrode incandescent along its whole length, so that it is covered with a sheet of flame from which dart flashes of bluish light with little explosions. At the same time on the first electrode, where the current density has remained constant, appears a copious evolution of gas, without comparison greater than it was at first, when the other electrode did not exhibit this phenomenon of recombination. This gas is found to be a mixture very rich in hydrogen. If it is a salt that is being decomposed, a considerable deposit of metal takes place on the second electrode, which is seen by simple inspection, without the necessity of weighing, to be very much greater than that which would have taken place under ordinary conditions. If on the electrode whose surface has been kept constant, the current density is so small that no trace of decomposition appears on it; still, as soon as the first electrode commences to be incandescent, the products of decomposition immediately appear on the second, which, in the case of solid ions, at once becomes covered with a metallic deposit, just as if it formed the negative electrode of a voltameter traversed by a direct current.

A similar result occurs if one of the electrodes, without being covered by a sheet of gas from which starts a continuous series of explosions, is surrounded by liquid in a state of strong ebullition, so that, without any luminous phenomena, the electrode gives out a feeble sound resembling the hum of a gnat. In order to carry out this experiment, it is sufficient to inclose the electrode in a porous cell immersed in the liquid. After starting the current, as soon as the density reaches a suitable value the liquid enters into ebullition.

If a third electrode of platinum is placed in the voltameter containing the two electrodes when the above experiments are being made, and a wire carried from it to one terminal of a galvanometer, the other terminal of which

*Continued from The Electrical World, August 8, 1891.

* *Pogg. Ann.*, vol. CXLVIII., p. 147.

can be connected by means of a key to either of the two original electrodes, it is found on suddenly breaking the alternating circuit that, while the electrode that became incandescent is either not polarized at all, or only very feebly so, that with the largest surface shows strong polarization, the direction of the current being the same as that from the copper pole of a volta couple.

On inserting other voltameters containing sulphate of copper, nitrate of silver, etc., in series with the first, and placing therein electrodes of such an area that decomposition does not occur when the alternating current passes through them, as soon as the above phenomenon takes place, the intensity of the current remaining constant, an active electrolytic decomposition commences, with deposition of copper, silver, etc., in each of the other voltameters.

REAL AND APPARENT ENERGY EXPENDED IN VOLTAMETERS TRAVERSED BY ALTERNATING CURRENTS.

If in an alternating current circuit an acidulated water voltameter is replaced by a wire of equal resistance the current will be increased; and if several voltameters, all of equal resistance, are constructed with electrodes of different areas and successively inserted in the circuit it will be found that that with the smallest electrode area will give the greatest current. This experiment was made by Kohlrausch in 1873,* and he deduced from it that it was not possible to apply Ohm's law to liquid conductors, and was forced to admit that the small quantity of gas produced by an alternation developed an appreciable electromotive force.

The investigations given above show that the phase of the difference of potential at the voltameter poles is displaced with regard to that of the current, and that polarization, like self-induction, does not interfere with the sinoidal character of the alternating current, but that the new curve obtained by the action of either of these two causes is displaced and diminished with regard to that which would have been found if neither polarization nor self-induction had been present. Consequently, the energy really expended at any instant in a voltameter traversed with an alternating current cannot be measured by the product of the current as determined by an electro-dynamometer, and the potential difference between the voltameter poles as determined by an electrometer or a Cardew voltmeter, but a wattmeter has to be used. I had a very sensitive one with a reflecting mirror made for me by Messrs. Ganz & Co., of Budapest, which was capable of measuring very exactly the work expended in a conductor of low resistance traversed by feeble currents. The errors introduced by the instrument through the want of perfect synchronism in the currents in the two circuits, owing to self-induction in the movable coil,† were in my case absolutely negligible.

A series of thirteen experiments, made with eight equal voltameters constructed of platinum wire of an area of .785 square centimetres each, supplies a good example of the way in which the energy really expended in the voltameters (as measured by the wattmeter) diminishes in comparison with that apparently expended (as measured by the indications of a mirror voltameter, comparable to a Cardew, and an electro-dynamometer) as the current density at the electrodes is diminished and the quantity of gas evolved is reduced. At starting, a current I of 1.798 ampères was used, which was gradually decreased, readings being simultaneously taken with the reflecting wattmeter, the reflecting voltmeter, and the electro-dynamometer. The following table gives the results of the measurements:

I.	W.	V × A.	W/V×A.	Remarks.
1.798	40.322	45.989	0.876	Copious evolution of gas.
1.810	38.371	45.535	0 842	" " "
1.406	31.690	35.585	0.890	" " "
1.058	20.746	25.152	0.824	" " "
1.184	20.413	26.611	0.767	" " "
0.837	13.507	18.573	0.727	Evolution of gas diminishing.
0.756	10.710	15 128	0.707	Feeble evolution.
0.788	10.009	14.873	0.672	" "
0.693	9.038	13.163	0.686	" "
0.8 3	8 804	13.889	0.634	Very feeble.
0.621	6.683	10.853	0.615	"
0.503	4.628	8.290	0.558	Hardly perceptible.
0.489	4.519	7.858	0.575	" "

Mean number of alternations, 86 per sec.

In this series of experiments, the voltameters having equal electrode areas, and being placed in series, the same amount of gas was produced in each. In another set of experiments, in which the electrodes were of different areas, so that, being still in series, for the different current density on the electrodes the amounts of gas liberated were also different. Four voltameters were placed in series, and in each one of the two platinum electrodes had a surface of such size that, with a current of two ampères, no decomposition was apparent at it. The surfaces of the other electrode in each voltameter were as follows:

Voltameter I. = 0.5110 sq. cm.
" II. = 0.7386 "
" III. = 1.5606 "
" IV. = 3.1056 "

The results obtained are given in the table at the top of the next column.

This second series of observations is given to show that, whether the current traversing the voltameter remains practically constant or is allowed to vary between narrow limits, if the difference of potential between the poles of the voltameters is reduced a continually increasing diminution takes place in the ratio between the real and the apparent energy absorbed in the voltameters. This alteration in the ratio can be readily explained, and is a consequence of the principles already given.

I.	W.	V × A.	W/A × V.	Total active surface in sq. cms.	Number of voltameters in which gas appeared.
1.477	28.911	40.855	0.707	5.826	4 copious evolutions
1.481	28.706	40.886	0.702	5.826	4 " "
1 494	28 402	40 590	0 699	5.826	4 " "
1.510	28.292	40.796	0.693	5.826	4 " "
1.510	28.247	41.015	0.688	5.826	4 " "
1.508	28.249	40 962	0.689	5.826	4 " "
1.547	26.458	38.638	0.684	5.826	4 smaller "
1.514	23.987	35.522	0.675	5.826	4 slight "
1.610	20 455	33.117	0.617	2.810	3 feeble "
1.620	21.238	34.745	0.611	1.250	2 slight "
0 482	2.259	4.455	0.507	0.511	1 hardly perceptible
0.487	2.303	4.484	0.514	0.511	1 " "

Mean number of alternations, 85.5 per sec.

In order to facilitate the consideration of the question we will assume that the expression for the polarization holds good for high values of the latter. Although this is not absolutely true, still, to make our reasoning correct, it is only necessary to substitute for the sine function employed that which really expresses the polarization, we have already proved that the difference of potential at any instant between the poles of a voltameter traversed by an alternating current is equal to the potential difference between the extremities of an equal resistance without induction or capacity, plus the value assumed at the instant by the electromotive force of polarization. The curve representing the former function is sinoidal, and synchronous with that giving the current; that representing the second is only sinoidal so long as decomposition in the voltameter does not take place; if decomposition does occur the curve is made up of portions of sine curves connected by straight lines parallel to the axis of abscissæ.

The resultant of the two curves of potential difference and polarization in the case when decomposition does not occur is a new sine curve, such as $V V' V''$ (Fig. 1), the resultant of $O B T$, $P P P''$, and in this case of $V V' V''$ will be found to be as far displaced as possible from that of current, which is represented by $O A T$. If, by increasing the current density at the electrodes or reducing the number of alternations, electrolytic decomposition is started and subsequently increases, the sine curve $O B T$ synchronous with $O A T$ (Fig. 1) must be combined with $C M N$ (Fig. 2), or with $C M_1 N_1$, and it follows that the resultant is no longer a sine curve but a deformed curve, of which the phases approach more closely to those of the current as the straight lines $M N$, $M_1 N_1$ become longer, that is, the greater is the quantity of electrolyte decomposed.

In the limiting case, when the amount of the electrolyte decomposed by an alternating current is equal to that which would have been decomposed by a continuous current giving equal quantity, the curve corresponding to $C M N$ will coincide with the axis $O T$, and the phase of $V V_1 V_2$ will, in the result, be synchronous with that of the current. In such a limiting case, the amounts of energy really and apparently expended in the voltameter will be identical.

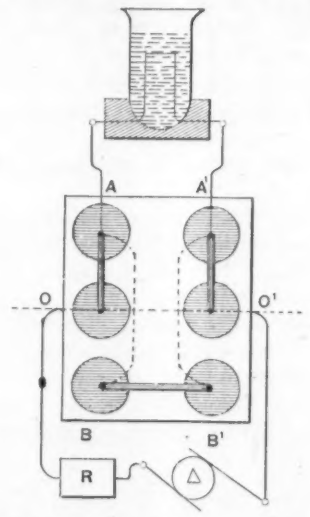


Fig. 4.—Electrolysis by Means of the Alternating Current.

There is a very great similarity between an electrical transformer and a voltameter traversed by an alternating current. The resistance of the secondary circuit in the transformer, and the quantity of the electrolyte decomposed in the voltameter, exercise precisely similar effects on the current. When the external resistance in the secondary circuit of a transformer is zero, the phases of potential difference and current are very near to synchronism, and the same thing is true when there is no difference between the amounts of an electrolyte decomposed by an alternating current and by a continuous current giving equal quantity. When the external resistance of the secondary of the transformer is infinite, and electrolytic decomposition does not take place at all in the voltameter, the difference between the two phases reaches its maximum. The same thing may also be said for the difference between the energies really and apparently consumed in the voltameter.

EXPERIMENTS WITH INTERRUPTED DIRECT CURRENTS.

Platinum is the only metal which is not acted upon when it is used as an electrode for the electrolysis of water by means of a direct current; when other metals are used the positive electrode is seen to become covered with a black or brown film which, after having reached a certain thickness, finally stops the internal development of hydrogen at the negative poles. The layer of brown powder formed round the positive electrode is then seen to dissolve, and then the electrode itself is vigorously attacked.* The positive electrode may thus be completely dissolved, but this, of course, requires a considerable space of time. Gold is not an exception to this rule, as it becomes covered with a dark red powder at the positive pole. Platinum, however, is not acted upon, but both poles remain quite bright, even when the duration of the current is considerable.

On the other hand, in electrolysis with an alternating current, the film of brown powder quickly appears at both platinum electrodes when feeble or strong currents are used. Consequently, the properties of platinum, in conjunction with alternating and continuous currents, are very different. The difference, however, disappears when, instead of direct continuous currents, we use direct currents made to alternate by means of a commutator, or (which is more important) when direct intermittent currents are used, and the voltameter is so arranged that it is short circuited at the conclusion of any current impulse and remains so until the commencement of the next.

In order to study this phenomenon, I made use of the apparatus represented in Fig. 4. An oscillating interrupter, consisting of six mercury cups, was constructed, its movable part being a plate of ebonite, above which were placed three pieces of copper wire terminating at the six points $A A'$, $B B'$, $O O'$; when the ebonite plate oscillates about the axis $O O'$, contact is made between the wires and the cups, either at $A A'$, or at $B B'$. The wires from an acidulated water voltameter were connected to the mercury cups under $A A'$. The leads from a direct-current dynamo, Δ, after passing through a resistance, R, pass to the cups under $O O'$, so that for half an oscillation of the interrupter the current passes through the voltameter, which, during the other half oscillation, is short circuited by way of the wires represented by dotted lines passing from the cups A A' to $B B'$, which two latter are joined for half an oscillation by the thick wire $B B'$. This interrupter was worked by a small motor and a registering mechanism was attached to count the number of times that the current passed through the voltameter. About 70 interruptions per minute were produced.

After 20,296 oscillations with a current of 0.171 ampère, the negative electrode was covered with a blackish film, the positive being quite bright. Since the blackening always takes place at the negative pole, it must be due to the action of the hydrogen. A difference of current density at the two electrodes has no effect on this blackening. The phenomena are obtained either with electrodes of equal surface or not, whether they are very small or not, and when the current density is below .01 ampère per square centimetre.

No such result as we have above described occurs if the voltameter is not short circuited when the current through it is cut off. On using the apparatus shown diagrammatically in Fig. 4, after removing the wire between B and B', both the platinum electrodes were found to be perfectly bright after 60,720 interruptions with a current of .161 ampère. When the wire $B B'$ was replaced, 4,420 oscillations were sufficient to start the blackening of the surface.

This experiment makes it clear that, in order to reproduce this characteristic of platinum electrodes in electrolyzing water by an alternating current, it is not necessary to make use of a direct current caused to alternate by means of a commutator, but it is sufficient if a polarization, constant in sign but rapidly pulsating in magnitude, occurs at the negative electrode.

On the Use of the Silver Voltameter

The following note on the use of the silver voltameter has been prepared by the Electrical Standards Committee of the London Board of Trade:

"In the following specification the term 'silver voltameter' means the arrangement of apparatus by means of which an electric current is passed through a solution of nitrate of silver in water. The silver voltameter measures the total electrical quantity which has passed during the time of the experiment, and by noting this time the time average of the current, or, if the current has been kept constant, the current itself can be deduced.

"In employing the silver voltameter to measure currents of about 1 ampère the following arrangements should be adopted: The cathode on which the silver is to be deposited should take the form of a platinum bowl not less than 10 centimetres in diameter, and from 4 to 5 centimetres in depth.

"The anode should be a plate of pure silver some 30 square centimetres in area and two or three millimetres in thickness. This is supported horizontally in the liquid near the top of the solution by a platinum wire passed through holes in the plate at opposite corners. To prevent the disintegrated silver which is formed on the anode from falling on to the cathode, the anode should be wrapped round with pure filter paper, secured at the back with sealing-wax.

"The liquid should consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of salt to 85 parts of water.

"The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that

* *Pogg. Ann.*, vol. CXLVIII., p. 146.
† *The Electrician*, vol. XX., p. 612.

* *Planté*, p. 10.

of the voltameter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms.

METHOD OF MAKING A MEASUREMENT.

"The platinum bowl is washed with nitric acid and distilled water, dried by heat, and then left to cool in a desiccator. When thoroughly dry it is weighed carefully. It is nearly filled with the solution, and connected to the rest of the circuit by being placed on a clean copper support, to which a binding screw is attached. This copper support must be insulated. The anode is then immersed in the solution, so as to be well covered by it, and supported in that position; the connections to the rest of the circuit are made. Contact is made at the key noting the time of contact. The current is allowed to pass for not less than half an hour, and the time at which contact is broken is observed. Care must be taken that the clock used is keeping correct time during this interval.

"The solution is now removed from the bowl and the deposit is washed with distilled water and left to soak for at least six hours. It is then rinsed successively with distilled water and absolute alcohol, and dried in a hot-air bath at a temperature of about 160° C. After cooling in a desiccator it is weighed again. The gain in weight gives the silver deposited.

"To find the current in ampères this weight, expressed in grammes, must be divided by the number of seconds during which the current has been passed, and by .001118. The result will be the time average of the current, if during the interval the current has varied.

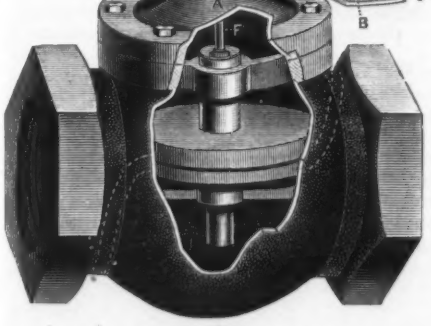
"In determining by this method the constant of an instrument, the current should be kept as nearly constant as possible, and the readings of the instrument taken at frequent observed intervals of time. These observations give a curve from which the reading corresponding to the mean current, time average of the current, can be found. The current, as calculated by the voltameter, corresponds to this reading."

The Neu Electric Leakage and Flow Detector.

Much attention has been devoted by those interested in automatic sprinkler systems to producing a device which will with certainty give an alarm when one or more sprinklers of a system open or are subjected to leaks. Such a device, besides requiring to work with delicacy and certainty, must offer no impediment to the flow of water from the sprinkler in case of fire or other need.

Mr. Gustave S. Neu, the well-known electrical engineer and contractor, has recently brought out a most perfect device of the above kind—one which seems to answer all of the above requirements with great simplicity of construction. The Neu device, of which we give herewith an illustration, is practically an ordinarily designed check-valve with the electrical arrangement secured on its top. The valve disc when raised by the slightest movement of water, pushes a delicate rod *F* into a cylinder filled with oil against a cam not shown in cut. To this cam is connected by means of a spindle the arm *A*, the friction roller of which in moving upward brings the upper extremity of the quadrant lever into contact with spring *C*, and closes the electric circuit.

The slightest first movement of the arm throws lever *B* its full swing, while any further advance upward simply serves to hold the lever in contact. When the arm *A* has reached a nearly vertical position the rod *F* and the valve disc are entirely free to move up or down without affecting any other parts. When the valve closes again all parts return to their normal position and the circuit is open. The oil in the cylinder serves to lubricate the interior moving parts and is kept there indefinitely by the water.



THE NEU DETECTOR.

Lieb Railway Specialties.

The accompanying illustrations show two improved devices for street railway line work recently put upon the market by Mr. C. A. Lieb, of 17 to 27 Vandewater street, New York City.

Fig. 1 shows a centre curve insulator. This is made of locust wood, with caps of mild steel pressed upon the tapered ends of the wooden centre piece in exactly the same way as is done in the Lieb Universal Insulator, which has already been described in THE ELECTRICAL WORLD, except that the eyes and cups are in one piece, making the insulator simpler and saving the expense of extra eyebolts. Fig. 2 shows a complete pull-off bracket, the body of which is also made of locust wood. After several years of experimenting in work, Mr. Lieb has concluded that locust wood is the best insulating material to use for a fixture that is subject to all the abuses of an insulator on a street railway curve. The shrinking or expanding of the wood in dry or wet weather does not affect the insulator, as the wood is larger at the bottom of the cups. When a strain is put on the insulator it acts as an inverted wedge, and the wood inside of the cups is compressed, preventing splitting, etc. The more strain placed upon the insulator the tighter will it be made to fit in the cups. These latter are made straight or cylindrical in form, and are thus closed over the tapered end of the wood by machinery constructed especially for the purpose. An extra heavy steel gooseneck and brass pull-off clip are made for large sizes of wire.

FIG. 1.—LIEB'S TROLLEY WIRE PULL OFF.

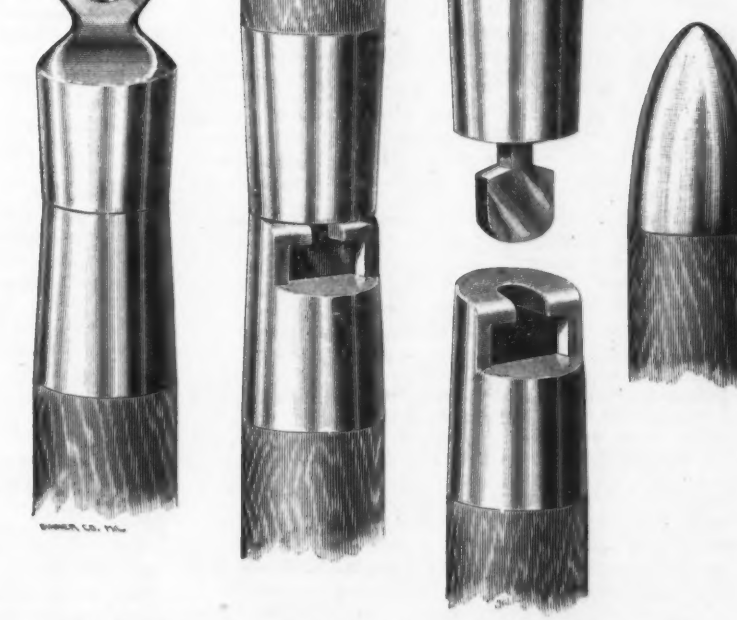
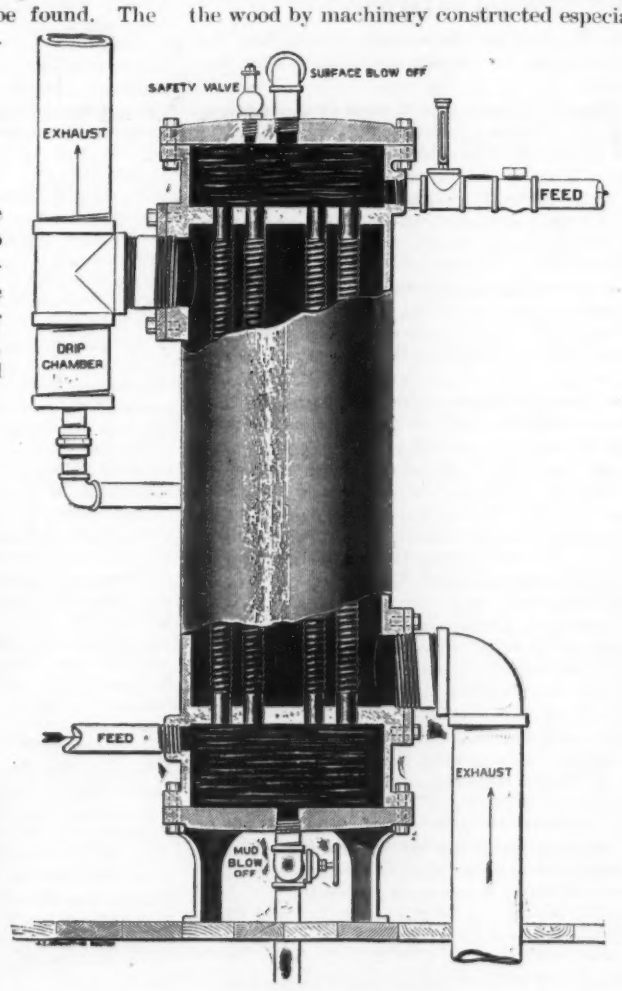


FIG. 2.—LIEB'S TROLLEY WIRE INSULATOR.

The New Wainwright Feed Water Heater.

The heater which we herewith illustrate is the latest product of the Wainwright Manufacturing Company, of Massachusetts, and was designed to meet the demand for a first-class heater at a moderate price, and that they have succeeded in doing so is evident from the many orders already received for these goods.

This heater is of the corrugated straight copper tube type which eliminates the danger of cracked tubes resulting from expansion and contraction and combines many other valuable improvements which enter into the details of a successful heater. There are upwards of 250,000 h. p. of the heaters of this company now in use, a fact which certainly is a good proof of their popularity.



THE WAINWRIGHT HEATER.

A "Needle" for Underground Conduits.

In the accompanying illustrations is shown what may fairly be termed a needle for underground conduits. It is manufactured and placed upon the market by Julius Andrae, of Milwaukee, Wis. It is intended for use in the operation of underground conduits as a substitute for the sectional gas-pipe rod, or wooden rod fitted with gas-pipe couplers, often used for this purpose, the operation of which required considerable time, and the service of two men at each manhole. A conduit 450 feet in length between manholes required from one to two hours' time for the operation of the ordinary method. It is claimed that with the apparatus shown in the accompanying illustrations the same result can be obtained in not more than 15 minutes, and the services of only one man. The first piece of the rod which is inserted from the manhole into the conduit has a cartridge point to overcome uneven or rough spots which may be met with on the interior. All additional rods join to the first one, lock into each other until the last one is reached, which has for an end piece a swivel to which the wire is attached. It will be seen that by this means even crooked wire may be made to easily follow the rods, no binding taking place, as the swivel makes it impossible for the kinks in the wire to interfere with its being drawn into the conduit. The apparatus here shown is now in use by the local companies of Milwaukee and is giving excellent satisfaction. The rods are made of hickory wood with patent malleable iron couplings fastened securely to them. The apparatus is only intended to thread the conduit with a wire of any sort which is strong enough for the purpose, and this latter is then used to draw the cable into its proper place.

THE ANDRAE CONDUIT THREADING APPARATUS.

The Photogenic Efficiency of Various Sources of Light.

In a recent communication to the Académie des Sciences, at Paris, M. Witz gives the following figures relating to the comparative photogenic efficiency of various sources of light.

If we take the arc lamp as our standard the comparative efficiencies are as follows: Arc lamp, 100; glow lamp, 20; regenerative gas-burner, 2.1; ordinary gas-burner, .7; stearine candle, .56.

Sources of light.	Expenditure.	Calories transformed.	Intensity in carcels.	Calories per carcel hour.
Stearine candle	10.5 grammes per hour.	110	1/6.5	716
Ordinary gas-burner	105 litres per hour	567	1	567
Regenerative lamp	35 litres per hour	189	1	189
Glow lamp	3.5 watts per candle	3.1	1/6.5	20
Arc lamp	4.5 watts per carcel	4	1	4

The Annual Clambake of the American Electrical Works.

The American Electrical Works, of Providence, R. I., of which Mr. Eugene Phillips is president, tendered its thirteenth annual bake to the electrical profession at Vue de l'Eau last Saturday. Upwards of 200 gentlemen, representing the various departments of the electrical business, gathered at the resort, and the programme of entertainment was sufficiently varied and interesting to fill up the hours from the time of registration to the departure of the evening boats. The majority of the party reached the grounds about 11 o'clock, and were cordially greeted by the reception committee in the annexes.

Richard's orchestra played at frequent intervals during the day, and impromptu choruses were sung to piano accompaniment. At two o'clock Governor Ladd, Mayor Smith and ex-Senator Greene, of Warwick, joined joined the company and were cordially received. In the meantime some of the fraternity engaged in target practice, some marvelous scores being made at 50 yards, while others took a hand at base ball, cane ringing, football, pool and card playing. The dinner was served at 2:30 o'clock in a tent south of the dining hall, and at each plate was an handsome pack of cards, upon the back of each one being a reminder of the generous host of the day. A neat menu card detailed elaborate courses of food whic happealed irresistibly to epicurean fancy. Members, armed with fish horns add other ear-splitting instruments, kept up a lively chorus, and everybody was in the best of spirits.

It was decided to have a season of post prandial oratory, and President Phillips selected Mr. T. D. Lockwood, of the American Bell Telephone Company, to preside as toastmaster—a most excellent selection. President Phillips responded for the "American Electrical Works," Gov. H. W. Ladd for the "State of Rhode Island," A. J. DeCamp, of Philadelphia, for the "Electrical Profession," Mayor C. Sydney Smith for the "City of Providence," George M. Phelps for "The Telegraph and Telephone," and Ralph W. Pope for the "Electrical Press." The several respondents spoke briefly and happily, and the speeches were enthusiastically received. Then came a sort of go-as-you-please picnic, interspered with singing and general hilarity, which continued without cessation until sunset. Then the company gradually diminished in numbers, several taking the train for Boston, while others caught the New York boat. Quite a number tarried under the guidance of Providence friends, and in the evening they visited the theaters and shore resorts, and found amusement in various forms. Fortunately for all those present, the day was delightful throughout in atmospheric and social conditions. The fourteenth annual bake will be looked forward to with lively anticipation, and abundant promise of a joyous reunion of the electrical profession of the country.

The register showed the following attendance:

NEW YORK.—C. W. Price, R. Walker, E. D. Moore, J. D. Bates, J. A. Cooney, J. F. Carney, E. Caldwell, C. E. Stump, P. H. Alexander, L. H. Hart, F. H. Lord, F. H. Hopper, R. S. Brown, C. H. Barney, E. E. Wood, G. M. Phelps, S. L. Coles, W. M. Stadler, W. J. Johnston, G. D. Stonestreet, P. C. Ackerman, R. W. Pope, B. F. Hamilton, W. K. Hermit, G. H. Walbridge, F. W. Harrington.

BOSTON.—E. D. Floyd, G. L. Bunker, G. M. D. Fernald, H. B. Cram, D. A. Harrington, W. C. Fish, E. R. Tilton, A. D. Blodgett, J. Taylor, A. V. Smith, M. W. Brown, J. H. Craig, C. A. Baldwin, W. M. Turner, F. W. Crocker, W. C. Woodward, A. C. Shaw, C. Burgher, H. J. Pettingell, A. D. Wheeler, J. L. Lucas, S. S. Sherman, C. J. Burleigh, C. W. Whitney, Jr., H. F. Kellogg, H. P. Stanwood, H. M. Nichols, G. L. Austin, C. E. Bibber, W. J. Barker, D. A. Andrews, E. J. Garfield, J. P. Felton, H. J. B. Straw, L. H. Lang, J. W. Poole, G. W. Adams, L. S. Dumoulin, W. S. Key, T. D. Lockwood, F. Ridlon, W. E. Decrow, N. W. Lillie, F. E. Pettingill, J. M. McLaren, G. B. Davis, H. F. Woods, F. M. Kimball, F. J. Boynton, J. K. Butler, J. H. Clark, E. M. Whiting, J. S. Keenan, J. H. Bilber, F. A. Gilbert, G. H. Almon, W. E. Geer, E. W. Tyler, L. Cofren, C. H. Herrick, F. Luther, F. M. Gilley.

PROVIDENCE, R. I.—C. Hughes, A. D. Sayward, H.W. Ladd, C. W. Baker, C. P. Chappell, A. Wright, E. Byrnes, G. H. Darling, S. R. Payson, W. A. Hathaway, A. C.White, J. F. Hedge, Jr., C. S. Smith, J. O. Darling, E. C. Perkins, C. H. Williams, G. H. Thurston, A. C. Barstow, Jr., A. Smith, W. N. Munro, E. R. Phillips, M. C. Day, G. H. Heathcote, C. R. Remington, Jr., C. G. A. Peterson, A. P. Crowley, H. C. Dangstaft, R. M. Whitton, W. W. Dempter, W. Pinkham, J. Tregoning, J. S. Drake, W. H. Sawyer, E. F. Phillips, E. M. Carhart, H. G. Wright, V. A. Thomas.

AUBURN, R. I.—H. H. Sherman.

BRISTOL, R. I.—J. A. C. Hamill.

PAWTUCKET, R. I.—W. McGregor, E. C. Kine, Jr., N. B. Denison, C. E. Locke, G. S. Stump, J. E. Andrews, D. C. Fales.

RIVER POINT, R. I.—H. D. Greene.

ANDOVER, MASS.—G. W. Foster, J. E. Whiting.

ATTLEBORO, MASS.—M. E. Clemons, L. W. Dillon.

BROCKTON, MASS.—J. M. Hollywood.

BRISTOL, MASS.—H. B. Emery.

BRIDGEWATER, MASS.—R. C. Breck.

CHELSEA, MASS.—D. J. Coburn.

FALL RIVER, MASS.—O. Durfee.

HOPEDALE, MASS.—A. T. Gifford.

LEICESTER, MASS.—W. F. Whitman.

LYNN, MASS.—H. D. Sears, W. B. Lewis, A. T. Rogers, C. C. Fay, J. F. Baker.

LOWELL, MASS.—C. A. Grant.

LEOMINSTER, MASS.—H. L. Pierce.

NEWTON, MASS.—F. Murdock, W. E. Holmes, W. J. Leonard.

NEW BEDFORD, MASS.—G. R. Stetson, W. K. Wagner, R. S. Faber.

PITTSFIELD, MASS.—E. M. Wilson.

SOMERVILLE, MASS.—T. E. Smith.

TAUNTON, MASS.—A. Coleman.

WORCESTER, MASS.—H. H. Fairbanks, W. H. Coughlin, W. H. Vialle.

UXBRIDGE, MASS.—G. Wilmot.

HARTFORD, CONN.—W. H. Babcock, J. J. Gates, C. G. Perkins.

NEW BRITAIN, CONN.—L. C. Whitney, W. C. Bigelow.

NEW HAVEN, CONN.—E. M. Clarke, E. B. Baker.

PUTNAM, CONN.—J. B. Tatem.

STAMFORD, CONN.—N. B. Griffin.

WHITINSVILLE, CONN.—M. P. Burbank.

WINDSOR LOCKS, CONN.—E. B. Bailey,

PHILADELPHIA.—A. J. DeCamp, H. A. Cleverly, G. F. Porter, H. B. Cutter.

BROOKLYN.—E. F. Peek.

SYRACUSE, N. Y.—J. C. Keeffe, A. P. Seymour.

PORTLAND, ORE.—H. W. Hamblin.

MONTREAL, CAN.—J. Carroll.

GREENVILLE, N. J.—H. Stewart.

AUBURN, ME.—F. E. Bisbee.

CHICAGO.—F. X. Cicott.

TOPEKA, KAN.—S. P. Baker.

The Electro-Deposition of Zinc and Aluminium.

The following receipt for an electrolytic bath is given by Kaselowsky, of Berlin :

Sulphate of zinc	10 kilogrammes.
Glucose	5 "
Water	100 litres.
Sulphate of aluminium	200 grammes.

Weak but constant currents must be employed, and the strength of the bath must be kept up by the addition of fresh quantities of the soluble salts of zinc and aluminium. Kaselowsky has also obtained good results from a bath composed as follows :

Chloride of zinc	6 kilogrammes.
Glucose	5 "
Water	100 litres.
Chloride of aluminium	350 grammes.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

TELEPHONE STOCKS.

Chicago	$230@	$240	Cumberland	$60@	$62
Central Union	52@	53	Wisconsin	118@	120
Michigan	83@	84	Bell of Missouri	160@	165
Great Southern	30@	32	Iowa Union	20@	22
Colorado	34@	36	Missouri and Kansas	54@	56
Rocky Mountain Bell.	40@	43			

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$95@	$100	Chicago Edison Co	$145@	$150

NEW INCORPORATIONS.

The Menlo Park (N. J.) Electric Company has been incorporated by L. M. M. Hussey, J. F. Morton and others to manufacture electrical supplies.

The Enterprise Electric Light and Railway Company, of Kankakee, Ill., has been organized with a capital stock of $100,000. The incorporators are Thomas H. Magunder, August D. Ehrick and William A. McGillis.

The Highland (Ill.) Electric Light and Power Company has been formed with a capital stock of $8,000, for the purpose of furnishing electric light and power. Edward Fentz, Henry Buchheim and Fred Siegrist are its incorporators.

The Edison Electric Illuminating Company, of Atlanta, Ga., has been incorporated, with a capital stock of $10,000, to generate electricity and furnish it for all the purposes to which it may be applied. Its promoters are J. F. Dickinson, W. H. Rhett and W. H. Inman, of Atlanta.

The Continental Development Company, of Richmond, Va., with a capital stock of $800,000, has been organized to prosecute the business of manufacturing machinery and electric equipments, etc. The promoters are L. Lamb, T. A. Lamb, J. E. Tarpin, J. H. Harvey and A. H. Fekthaus.

The Northwestern Street Railway Company, of Chicago, has been organized with a capital stock of $25,000, to construct railways in the towns of Leyden, Proviso, Cicero, Maine and the city of Chicago. Eugene B. Weeks, Alfred A. Ellsworth and John L. Pearson are its incorporators.

The Maryville Electric Light and Power Company, of Maryville, Mo., has been organized with a capital stock of $25,000. Its purpose is to supply the city of Maryville with electric lights and electric power. The promoters are Wm. A. Ross and J. W. Smith, of Maryville, and J. H. Tracy, of St. Louis.

The Edison Light, Heat and Power Company, of Wheeling, W. Va., has been incorporated with a capital stock of $500,000, to prosecute the business of supplying light, heat and power by electricity to the people of Wheeling. The promoters are Alexander Mitchell, August Rolf and George E. Stifel, all of Wheeling.

The Brennan Compress Oil and Manufacturing Company, of Brennan, Washington County, Tex., has been incorporated with a capital stock of $150,000, for the purpose of operating an electric plant and prosecuting the business of ginning, baling and compressing cotton. Its promotors are D. C. Giddings, William Perry and Thos. Dwyer.

The Penn Yan (N. Y.) Electric Light and Power Company has been formed with a capital stock of $100,000 to manufacture electricity for light, heat and power. Its incorporators are H. Q. Stimpson, of Boston, Mass.; Henry Russell, of Albany, N. Y.; Calvin Russell, Jr., J. T. Birkett, Howard L. Woodruff, and W. S. Bruen, of Penn Yan.

The Crescent Insulated Wire and Cable Company, with its principal office at Trenton, N. J., and a capital stock of $50,000, has been incorporated to manufacture an insulating compound for covering wires and cables, and also for the manufacture of electrical appliances. R. R. Whitehead, C. Edward Murray and Harry T. Solliday, all of Trenton, are the incorporators.

The Steubenville Railway and Electric Company (incorporated in W. Va.), of Steubenville, O., has been formed with a capital stock of $100,000 for the purpose of operating an electric railway in Steubenville, O.; also for supplying light and heat. E. B. Gawthrop, and G. C. Hughes, of Pittsburgh, Pa., and Donald B. Toucey, of New York, are the incorporators.

The Roland Park Company, of Baltimore, Md., has been formed with a capital stock of $1,000,000, for the purpose of buying, selling, leasing, etc., etc., and dealing generally in land in Maryland; and also to supply water, manufacture and supply gas or electric light, outside of the limits of Baltimore. Its incorporators are Roland R. Conkling, Richard I. Capron and Douglas H. Thomas.

AFFAIRS OF THE COMPANIES.

The Thomson-Houston Electric Company reports its net shipments from the Boston office only, for the second quarter of 1891 (May, June, July,) as $2,261,606, against $1,798,467 for the corresponding period of last year, a gain of $463,139, or 26 per cent. By "net shipments" is meant shipments at actual contract prices, less all commissions and discounts and apparatus returned.

The Pacific Postal Telegraph and Cable Company held its annual meeting last week and elected the following directors for the ensuing year: John W. Mackay, William C. Van Horn, George Stethen, Charles R. Hosmer, Richard D. Gay, Albert B. Chandler, Edward B. Platt, George G. Ward and William H. Baker. The election for officers will be held on the first Tuesday in September.

The Erie Telegraph and Telephone Company last week recommended to the directors that the usual quarterly dividend of one per cent. be declared payable Aug. 17 to stockholders of record August 8. The statement of the Erie company for the three months ending June 30 is as follows: Gross income of the three sub-companies, the Cleveland, Northwestern and Southwestern, $208,782.57; expenses including dividends paid by the sub. companies, $198,000.36, leaving a surplus of $10,782.21. Proportion of dividends due the Erie company, $52,287.02; reserve for dividend No. 31, $48,000, leaving a surplus of $4,287.02. The increase of subscribers is 163, and the total number of subscribers connected July 1 is 13,589.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Aug. 10, 1891.

Mr. W. C. Bryant, of the Bryant Electrical Company, of Bridgeport, Conn., was in New York Wednesday. The careworn look Mr. Bryant has had of late is gone, and he beamed with happiness. Do you guess why? He is the father of a bouncing boy.

The Board of Electrical Control has ordered the Empire Subway Company to build subways on a designated list of streets for the use of the Edison Company. The work must be completed by Sept. 15. The Consolidated Subway Company was ordered to build a few strips of high tension subways. Ex-Judge Kelly, in behalf of the East River Electric Light company, asked that the Consolidated Company be compelled to extend the Grand street subway east of the Bowery to Goerck street. His application was granted.

The Two Sullivan Brothers.—In the resignation of Mr. M. C. Sullivan, as New York representative of the *Electrical Engineer* electric journalism loses one of its most popular representatives. Mr. Sullivan is one of the very few engineers who possess thorough electrical knowledge in addition to their ability as newspaper men. He has been connected with the electrical business since boyhood, his first experience being with the telephone. At various times he has been connected with the telephone companies at Pittsfield, Mass., Albany, Troy, Saratoga and Glens Falls, N. Y. In 1887 he came to New York for the purpose of entering a larger field of work. He secured employment with the then Edison Electric Light Company, where his ability as an engineer was soon recognized. In this company he had charge of the installation and operation of some of the largest plants. When the "alternating boom" set in Mr. Sullivan joined his fortunes with this new branch of the industry, but again associated himself with the Edison Company in the Autumn of 1889, leaving soon afterward to join the staff of the *Electrical Engineer*. He has resigned to take an active interest in one of the most important branches of electrical manufacture. Mr. Sullivan's good nature, perseverance and energetic business ability have won for him hosts of friends, who heartily wish him the greatest success in his new field of work.

The appointment a few months ago by the Edison General Electric Company of Mr. M. J. Sullivan as advertising agent, and chief dispenser of knowledge in the Intelligence Department, brought into prominence another of the bright young men in electrical circles. Though but 22 years of age, Mr. Sullivan's career has been one of the greatest activity. Coming from the inspiring atmosphere of the Berkshire Hills, he arrived in New York when only 16, a slight knowledge of short-hand, and a few dollars, his only capital and friends. After a short period of hard study, he took a position as stenographer with T. P. Burke & Co. in Chambers street. Here he remained until he was appointed private secretary to the celebrated moralist and reformer, Anthony Comstock. For several years he was the close friend and assistant of the great "St. Anthony," as he is popularly known. Shortly after this Mr. Sullivan connected himself with the Edison company, his first position being that of secretary to the Standardizing Bureau. In September, 1889, with his brother, Mr. M. C. Sullivan, he commenced a series of entertainments with the Edison phonograph. Their success was instantaneous, and during the season of 1889-90, they gave more than 200 exhibitions, ranking as one of the best novelties on the concert stage. When the Edison Electrical Exhibition was inaugurated at the Lenox Lyceum last year, Mr. Sullivan was called from his desk in the Edison Company to write and play the amusing little sketch entitled, "A Glimpse of the Twentieth Century." The interior of a New York home a hundred years hence, with all its conveniences, both electrical and mechanical, was represented, Mr. Sullivan playing the character of the ideal twentieth century bachelor. The little play had a seven weeks' run, and was witnessed by thousands. Mr. Sullivan's inimitable humor and sayings make him extremely popular with every one, and his host of friends are found in all parts of the country.

L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Aug. 8, 1891.

Messrs. J. B. Dillingham & Co., of corner Franklin and Oliver streets, Boston, Mass., have been appointed New England agents for the Smith & Vaille Pump Company, under the jurisdiction of the New York office.

Electrically Welded Shells.—The work of manufacturing welded shells is now in progress at the American Projectile Works, in Lynn, Mass., the method used being that covered by the Wood patents for welding projectiles by electricity.

The National Electrical Manufacturing Company, of Milford, Conn., has issued the following notice: "On and after Aug. 15, 1891, sales and deliveries will be made direct from the factory of the company, at Milford, Conn., where all orders and other communications should be addressed."

The Audubon Machine Works, of New Haven, Conn., announce that they have added to their business a department for the buying and selling of all kinds of new and second-hand engines, boilers and machinery; and that F. D. Buttricks, who has had many

years' experience, and is well known to the trade, will represent them on the road in New England and New York. The concern also request manufacturers' catalogues, and state that they are prepared to send competent men to set up engines and machinery.

The Rapid Transit Commissioners of the city of Boston have had several meetings lately at which different schemes were ventilated for securing better facilities for transportation of passengers in this city. Mr. Fitzgerald has been appointed a committee to visit the various large cities of Europe for the purpose of investigating the systems in use there, and starts this week. It is expected that he will be joined there next month by another member of the commission and they will then finish the work and return together bringing some valuable data.

An Electrical Museum at the Thomson-Houston Factory.—One of the most interesting places about the Thomson-Houston factories, says the Lynn *Press*, is the model-room in the basement of factory D. Here are hundreds of models of the various inventions patented by Prof. Thomson and the other inventors of the company. There are at least 100 different arc lamps, for Prof. Thomson has thoroughly covered this field. There are half as many different electric meters, and a great many electric switches, incandescent lamp sockets, motors of various kinds, dynamos, transformers, and an almost innumerable number of other devices. C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, CHICAGO, Aug. 8, 1891.

The Chicago Edison Company has subscribed $2,500 for the World's Columbian Exposition stock.

Change of Publication Office.—The *Telegrapher*, the official organ of the Brotherhood of Telegraphers, has been removed from Chicago to Fort Wayne, Ind., and is now owned by a stock company at the latter place.

For the Student in Electrical Traction.—Over one section of track in Cincinnati, cable trains, horse cars, double-trolley cars and single-trolley cars all pass during each hour of the day, thus forming a good point from which to study the merits of the respective systems.

Messrs. Charles T. Lindener & Co., of 319 Pine street, San Francisco, Cal., have secured the agency for the motors and incandescent dynamos manufactured by the Jenney Electric Company, of Indianapolis, Ind. Mr. Lindener has represented the McIntosh & Seymour Company on the coast, and his partner, Mr. J. N. Mathews, is the well-known superintendent of the engineering department of the Pacific Mail Steamship Line. F. DE L.

KANSAS CITY, Mo., Aug. 7, 1891.

Mr. Fred. S. Hatch, president of the Larned Electric Light Company, Larned, Kan., was a visitor here last week.

New Isolated Plant.—The A., T. & S. F. Ry. general offices and shops will soon be equipped with a new incandescent plant.

The Kansas City Calcium Light Company has opened a new office in the Auditorium, and is arranging to do an extensive business.

Mr. J. R. Mulvane, president of the Missouri and Kansas Telephone Company, with headquarters at Topeka, Kan., visited this city last week.

Mr. A. B. Conover, Jr., of John A. Roebling's Sons Company, is here from Chicago. He is well pleased with the business outlook for this section.

Bids Wanted.—The Board of Public Works has advertised for bids for the city's electric lighting. Arc lights must be of 2,000 c. p. each and cost not to exceed $100 per year for each lamp. Incandescents must be 16 c. p. and not exceed $15 per year in cost.

Mr. C. B. Humphrey, general agent for the Edison General Electric Company, with headquarters at Omaha, and Warner L. Beckwith, of the same company, at Chicago, were here to consult local capitalists in regard to a new electric line at Leavenworth, Kan.

The City Council has granted the Missouri and Kansas Telephone Company a franchise for underground conduits. Construction will shortly begin. The company moved its general offices to its new building this week. Superintendent Smith announces that the operating department will be transferred in five minutes' time. H. D. E.

SOUTHERN NOTES.

NORFOLK, Va., Aug. 8, 1891.

Goshen, Va.—The city's electric light plant is now completed, and gives general satisfaction.

Athens, Ga.—The dynamos for the electric road have arrived, and the line is now in operation.

Hillsboro, N. C.—The mayor of the city has let the contract for the erection of the electric light plant.

Kensee, Ky.—The Main Jellico Mountain Coal Company is putting in an electric light plant at its coal mines.

Old Point Comfort, Va.—Chamberlain's Hotel will be lighted with 3,500 electric lights. Five dynamos will be installed.

Eufaula, Ala.—This city's telephone system will soon be in operation. Mr. J. C. Thomas will have charge of the same.

Macon, Ga.—A $35,000 electric power plant will shortly be erected by the Macon City and Suburban Railway Company.

Charleston, S. C.—The Charleston Light and Power Company has advertised for proposals for the construction of its new power station.

Del Rio, Tex., was recently illuminated for the first time in its history by electric lights. The plant is said to be one of the finest in the State.

Athens, Ga.—A new armature and two more motors have been ordered for the electric light plant, to replace the ones that were recently destroyed by lightning.

Augusta, Ga.—The electric railway company has ordered twelve new electric motors of 25 h. p. each, which will be used in the hill cars. The present motors are of 15 h. p.

Bonham, Tex.—The work of laying the ties for the new motor street railway has been commenced. It is expected that the road will be in operation by the first of September.

Franklin, Va.—It is reported that a stock company is being organized at this place to erect an electric light plant. W. W. Moore is endeavoring to organize the company.

Norfolk, Va.—Superintendent E. L. Bugbee, of the Telegraph Weather Bureau, accompanied by his assistants, have gone to Capes Henry and Charles to repair the cables at those points.

Rockville, Md.—The Rockville and Tenleytown Electric Railroad Company has completed its road, and is now running cars on regular time. Work on the extension is now progressing rapidly.

Branchville, Md.—The Brighton Park Mutual Home and Investment Company has been incorporated with a capital stock of $250,000. The company will erect electric light plants, gas works, etc.

Clifton Forge, Va.—The Clifton Forge and Covington Telephone Company was recently organized in this city for the purpose of constructing a telephone line between Clifton Forge and Covington.

Rockingham, N. C.—The office of the Western Union Telegraph and Seaboard Air-Line System was recently struck by lightning, severely shocking the agent and damaging the switchboard.

Richmond, Va.—The work of stringing the wires for the Richmond Railway and Electric Company's line has been begun. Within a short time electric cars will be run from Main street to Manchester.

Newport News, Va.—The Peninsular Electric Light and Power Company will increase its capital stock about the middle of August. A meeting is to be held on Aug. 13, at which time the matter will be discussed.

Wheeling, W. Va.—A stock company has been organized here by Thomas O'Brien, R. Stalnaker, N. E. Whitaker and others, for the erection of an electric light plant. Work will be commenced within a short time.

San Antonio, Tex.—The San Antonio Rapid Transit Railroad Company's street lines will be operated in the future by electricity. The company is at work on the buildings, and will soon be ready for operations.

Athens, Ga.—The city's fire-alarm system was recently burned out by the crossing of the wires of the system and of the electric car line. The system will have to be thoroughly repaired. The loss was quite heavy.

Barlow, Fla.—A factory for the manufacture of C. J. Seeger's patent telephone instruments will be erected here by J. H. Gardner and J. E. Grady. A stock company has been organized with a capital stock of $25,000.

Lake Charles, La.—Mr. J. A. Landry and others have incorporated the Lake Charles Ice, Light and Waterworks Company, with a capital stock of $100,000. The company will soon begin the erection of an electric light plant.

Richmond, Va.—Dr. Burton, of this city, inventor of the railroad electric heater, has received a letter from the Pennsylvania Railroad Company informing him that his heaters will be used on the company's limited express trains during the coming winter.

New Orleans, La.—The Postal Telegraph Cable Company has for some time been endeavoring to obtain permission from the city to lay its wires underground. It is stated that satisfactory arrangements have been made, and that the company will soon begin the work.

Quanah, Tex.—Fort Worth capitalists have submitted a proposition to the City Council, asking that a franchise be granted them for the purpose of putting in a system of electric lights. The proposition was favorably received, and work will be commenced on the plant within a few days.

Covington, Ky.—A survey is being made to determine the best route for the Rosedale, Cincinnati and Covington electric road. There are two routes under consideration, and as soon as the company can decide upon the best one, the work of construction will be begun. The road will cost $150,000.

Washington, D. C.—The work of wiring the White House for electric lights will soon begin under the supervision of Passed Assistant Engineer George W. Baird. The House of Representatives will be provided with through cables connected with the dynamo in the State, War and Navy Building.

Norfolk, Ky.—The steamer Fairfax, owned by the Merchants and Miners' Transportation Company, will on its completion be supplied with an electric light plant. This is the first steamer on the line to be lighted by electric lights. The contract has been let to the Thomson-Houston Electric Company.

Washington, D. C.—At a recent meeting of the governing committee of the Washington Stock Exchange, $400,000 Chesapeake & Potomac Telephone Company gold 5 per cent. bonds were added to the regular list of securities; $100,000 United States Electric Light Company convertible 5 per cent. bonds were also added.

Basic City, Va.—The Cross Investment Company has been incorporated to erect electric light plants, gas works, etc. The capital stock of the company has been placed at $20,000, with the privilege of increasing to $50,000. The officers are: W. V. Kirk, of Paw Paw, Mich., president; E. P. Cahill, of Hancock, Md., vice-president, and J. N. Kirk, secretary.

Augusta, Ga.—Mr. A. V. Abbot, chief engineer of the Jarvis-Conklin Investment Company, of Kansas City, Mo., accompanied by an expert electrician, arrived in the city recently for the purpose of placing in the Summerville cars the new twenty-five horse-power motors, which were bought by the road a short time ago especially for the Summerville line.

Newman, Ga.—This city has for some time been agitating the question of establishing an electric light plant, and has at last contracted for its immediate erection. At a recent meeting of the City Council a contract was entered into with Mr. W. L. Dresser, of Albany, N. Y., for the erection of the plant. It is understood that work on the same will be commenced within a short time.

Washington, D. C.—A construction company, for the purpose of manufacturing and equipping street lines with the Prall motor car, the new power for street car propulsion, is being organized in this city. This system has been experimented with in this city for several months, and its operation on the experimental track has proved entirely satisfactory. It is expected that the line will soon be introduced in other parts of the country.

Atlanta, Ga.—The Edison Electric Illuminating Company, of Atlanta, has petioned the superior court of Fulton county, Ga., for a charter. The company will manufacture, buy, sell, lease and use machinery, articles, apparatus and devices of every kind appertaining to the use or application of electricity. The capital stock of the company will be $10,000, divided into shares of $100 each. The incorporators are J. F. Dickinson, Walter H. Rhett, W. H. Inman and others.

Milton, Fla.—The organization of a stock company for the purpose of erecting an electric light plant in Milton is being agitated. Mr. J. B. Crossland, a capitalist of Pensacola, has been in the city several days trying to effect an organization. It is stated that several business men of the city have given the matter a good deal of attention, and that they are willing to cooperate with Mr. Crossland for the building of the plant. The plant will consist of both the arc and incandescent lights.

Richmond, Va.—Dr. Hunter McGuire recently read a few notes before a meeting of the Academy of Medicine and Surgery on the use of medicine by the anodal diffusion, consisting in placing the medicine in a cup-shaped depression on the electrode of the positive pole of the galvanic battery and applying to the patient, who holds in his hands the negative pole, thus effecting a flow of current through the diseased part, which is at the same time in contact with the antiseptic or healing substance.

Richmond, Va.—The Continental Development Company was recently incorporated, with a capital stock of $40,000. The objects of the company are to manufacture dynamos, machinery, etc. The officers of the company are William Y. Ha mlin, Detroit, Mich. president; directors: Laurence Lamb, Memphis, Tenn.; J. R. Ogden, New York City; William L. Rice, Cleveland, O.; J. E. Turpin and T. A. Lamb, Virginia; Henry W. Avery, Cleveland, O. The principal office of the company will be in Richmond.

Augusta, Ga.—The greatest question before the people of Augusta now is as to whether the city will be lighted with electricity or gas. Some time ago Mr. Wm. H. Fleming, of the Thomson-Houston Electric Company, made a proposition to the city to furnish 400 arc lights at $100 a light per annum. The city pays the gas company only $16,850 for its lights, which is $23,150 less than the proposition made by Mr. Fleming. The question as to whether the city will be lighted by electricity or gas will soon come up in the council chamber.

Americus, Ga.—The citizens of this place are very much afraid that they will lose their electric street railway. The cars have all been taken to Macon, and it is stated that the wires and poles will follow in a few days. Americus granted the most liberal franchise to the company operating this line, and does not wish to be deceived after what it has done for the company. At a recent meeting of the City Council resolutions were passed for an investigation. Americus cannot very well do without street cars, and unless the company either operates or removes the line it will forfeit its franchise and be made liable to the city for damages.

Washington, D. C.—The Wheeless Electric Railway Company, of this city, of which D. F. Merrill, Jr., is secretary, has cautioned the public that it is the owner of all existing patents on the Wheeless underground and overhead system, and that no other company or person has the right to build or operate roads in accordance with this system. The reason that the company has cautioned the public in this matter is that certain parties, who claim to be the purchasers of certain charter privileges, contemplate the building of such a system in the District of Columbia.

Richmond, Va.—Messrs. E. R. Hix & Co., of Baltimore, Md., are the contractors who are placing the electric lights in the new Masonic Temple. Two 55-h. p. engines and five 10-light machines will generate the electricity for the building. When complete the building will be supplied with 1,100 lights, and will be without a doubt the finest lighted building south of New York City. The Grand Lodge room will have 152 incandescent lights. The large store on the ground floor will have 157 lights. Arc lights of different colors will be placed in the cupola of the temple, which will show to members which of the lodges is in session.

Washington, D. C.—A new cable to the West Indies is among the probabilities of the near future. Mr. F. N. Gisborne, the electrician of the government of Canada, who has been visiting in the West Indies for some time past, and who has been making a careful study of this important question, recommends the construction of the line, which will be an extension of the cable between Halifax and Bermuda, and will terminate at Demerara, touching on its route Fortune Island, the island of Jamaica, and passing through the Caicos passage. A London syndicate is very much interested in the movement, and it is expected that active preparations for the early completion of the line will soon be made.

Augusta, Ga.—The mayor of the city has advertised for sealed bids for lighting the city by electricity with 250 arc lights of 2,000 c. p., 125 incandescent lights of 32 c. p., and 75 incandescent lights of 65 c. p. At a recent meeting of the City Council the Lamp Committee wasinstructed to inquire into the advisability of the City Council establishing or erecting a plant of its own, to report to Council with the views of the committee as to the best plan to be adopted. Sealed bids will be received for erecting an electric plant of sufficient capacity to light the city, with not less than 300 arc lights, 150 incandescent lights of 32 c. p. and 100 incandescent lights of 65 c. p., bidder to include in bid all material, dynamos, labor, etc., and have said plant completed and lights ready for use by July 1, 1892.

Atlanta, Ga.—Mr. Atchison, representative of the Short Electric Motor Company, whose headquarters are in this city, is a nephew of ex-Senator Thomas H. Benton, of Missouri. In a recent interview with a reporter of the Atlanta *Constitution*, Mr. Atchison has this to say of the company's Short motor: "Our company has succeeded in doing away entirely with the gearing heretofore used. We accomplish this by arranging the armature so that it will make only the same number of revolutions as the wheels of the car. This not only saves a great deal of friction but prevents the burning out of armatures, which has heretofore been a very large item in the expense account of electric car lines. One of the most ingenious features of the motor is the way in which the independent current is generated in the armature, in order that the car may be stopped should the brakes fail to work, or if from loss of current from the plant the car should run down hill." V. N. B.

ENGLISH NOTES.

LONDON, July 22, 1891.

Electric Lighting Orders.—In the preliminary returns just issued by the Board of Trade, it is stated that 70 Provisional Orders have been applied for since the beginning of the year. In all, 58 of these have been granted, 34 to local authorities, 24 to companies. No less than 218 Provisional Orders have been granted since 1883, of which 157 are still in force, 94 of which belong to local authorities.

National Telephone Company.—Notwithstanding the large all-round reduction of rentals which came into force at the beginning of the present year, the gross revenue of this company for the year ending April 30, 1891, has increased from £411,000 to nearly £419,000; the number of subscribers in the same time having risen from 29,257 to 35,440, an increase of 13 per cent. The working expenses of the company are 43.5 per cent. of the gross rentals.

Electric Lighting in the City.—The electric lighting in the city has taken another step forward by the formation of the City of London Electric Lighting Company, which now comes before the public with the usual roseate estimate of its prospects, coupled with the request for £400,000 capital. The ultimate total capital of the company will be £1,200,000 and it is estimated that something over a million sterling will have to be expended in plant and mains. The board of the company comprises Sir David Salomons, Chairman, the Duke of Marlborough and the Earl of Suffolk.

Electric Traction in Paris.—A committee of the Paris Municipal Council has decided in favor of the construction of an electrical tubular railway running from the Bois de Boulogne to the centre of the city. The construction of a Metropolitan railway on the lines of the London underground system has long favored in Paris, with, of course, the substitution of electricity for steam. The present decision, I am informed, does not bring us much nearer to the actual construction of the line, as so many formalities have to be gone through and so many authorities satisfied before the work can be commenced.

Overhead Wires in London.—The London Overhead Wire Act (1891), which received Royal assent at the beginning of the month,

is a striking example of the English dislike to drastic measures. As originally drafted two years ago, the bill authorized the London County Council to construct a vast system of subways, to remove overhead wires, to employ uniformed inspectors with compulsory powers of entrance into private houses for the purpose of inspecting and removing overhead wires, and to make by-laws (to be approved by the Board of Trade) with regard to the registration, erection, maintenance and removal of overhead wires. In the bill which finally received Royal assent the power of making by-laws was alone retained.

Municipal Electric Lighting at Bradford.—At a recent meeting of the Bradford corporation the question of further additions to the municipal station which has been in operation for the past two years came up for consideration. It is proposed to add one 300-h. p. engine and two 80-h. p. engines. The chairman of the gas and electric supply committee stated that although they had not pressed the matter, being owners of the gas works, there had been a large and increasing demand for current, rendering further additions absolutely necessary. In reply to the opposition the chairman stated that the loss on the electric light works had been reduced from over £1,000 a year to about one-half that amount, and he had no doubt that in a year or two the works would be paying a handsome interest on the money expended. The proposed additions were sanctioned. The supply of Bradford is on the plain two-wire system with accumulators, and the price charged per unit is 6d., equivalent to gas at 5s. per thousand, the price of gas being only 2s. 3d.

London County Council and Electric Lighting.—In the report of the London County Council for the year ending March 31, 1891, it is stated that their station for testing electric meters will shortly be in operation. During the year in question the Council has sanctioned the laying of no less than 137¼ miles of electric light mains, 86¼ miles being for high-pressure current and 51 miles for low pressure current. In consequence of an accident to two persons in November last through some high-pressure mains belonging to the Deptford system having come into contact with the cover of a street box, the County Council, after consultation with the Board of Trade, issued a regulation that where high-pressure mains are used, the street boxes must be provided with an inner cover, the two to be insulated from each other as far as possible, and the outer cover to be efficiently connected to earth. Other adequate precautions to prevent such accidents may, however, be taken, and this particular precaution will probably not be insisted upon in the case of the present distributing mains connected with the Deptford system, since they are now all of the concentric type.

Edison-Swan Company.—As I remarked in a recent letter, although the actual business of supplying of electricity seems only to be a paying one in exceptional cases, almost all the other branches of electrical industry are now fairly prosperous. The steady dividends of the leading cable companies have long been proverbial, and the high dividends of the National Telephone Company have given force to the cry of "monopoly." Of late years also the makers of heavy machinery have found means whereby to make a profit, but perhaps the most remarkable leap from no dividend to a high rate has been that of the Edison-Swan company. This company, after for several years failing to pay the shareholders a single penny, is now in a position to give them seven per cent. for their money, and to pay off every year large portions of arrears of dividend. During the past year this company has received for lamps, etc., the sum of £143,000, as against £119,000 the previous year, an increase of 20 per cent., the net profits being respectively £71,000 and £63,000. Alluding to the large stock of lamps, etc., in hand, namely, £59,000 worth, the chairman stated at yesterday's meeting, that in face of the possibility of a great rise in the price of platinum, the company had secured a large quantity of this metal, and had now no less than £16,000 worth in stock.

LONDON, July 29, 1891.

Chicago Exhibition Commissioners.—The Chicago Exhibition Commissioners continue to entertain and be entertained, to interview and be interviewed. On Monday they were entertained by the Lord Mayor, and on Tuesday they interviewed Lord Cross, the Secretary of State for India, with a view of securing adequate representation of the products of that country at Chicago.

City and South London Railway.—A sad accident occurred on this line last week, owing to a passenger who was in a hurry forcing his way through the grill gates leading to one of the huge lifts, which was in motion. The unfortunate man missed his footing, was carried up hanging to the lift by his hands and decapitated. It is satisfactory to find that none of the daily papers have blamed electricity for the accident.

Street Transformer Boxes.—A decision of some importance, in view of the recently proposed idea of constructing sub-transformer stations under the London pavements, was lately arrived at by the London County Council. Mr. Ferranti's company, the London Electric Supply Corporation, recently gave notice of their intention of constructing a street box five feet square and six feet deep under the pavement; their idea being to place two transformers in this pit; a cellar hitherto used for this purpose being no longer available. The Highway Committee of the County Council were of opinion that such an interference with the public thoroughfare could not be sanctioned.

CANADIAN NOTES.

MONTREAL, Aug. 8, 1891.

The Standard Electric Company, of Ottawa, is pushing its work ahead and has nearly completed it in Montreal. Some idea of the feeling prevalent may be gained from the fact that the stock of the Royal Electric Company has taken a rise, and is now quoted at about 120. Passing through Lachine a day or so ago I noticed that the poles for the new electric light plant are all up. They are excellent poles, being straight as an arrow, and quite a relief from the ugly twisted ones you so frequently see. One of the most interesting items in connection with electric lighting is the recent failure of Messrs. Craig & Son, who were illuminating St. Henri, St. Cunegonde and Cote, St. Antonie, as also the harbor. Insufficient capital, with other things to handicap them, made a combination of misfortunes which the firm could not stand against. There is every probability of the affair being settled by purchase, however, and in the interim the different plants are being run by the Curator. There are now some two or three electric hoists running in this city, and as far as I can learn they are in every way satisfactory, and there is no doubt but that in the future this system of elevators will be in vogue. Apropos of elevators, there is plenty of room and a large number of passengers for another elevator to the summit of Mount Royal, and an electric one would undoubtedly be the most popular. The Eugene Phillips Electrical Works is very busy just now, orders flowing in all the time and keeping the company's genial manager, Mr. John Carroll, simply hustling. I imagine that he is one of the busiest men in the Montreal electrical world just now, having recently been appointed secretary to the sub-committee on exhibits for the great convention in September, and joint secretary of the citizens' executive committee. The work being done by the various committees on this connection is, by the bye, of a very satisfactory nature. The programme is nearly made up, and I expect to be able to send you a complete list of the proposed entertainments for next week. The citizens' committee is becoming more enthusiastic every day, and there is no doubt but that the convention and exhibition are going to be the most successful yet. A press committee composed of representatives of the Montreal press is in course of formation, and you may be sure that our journalistic visitors from the United States will receive a hearty welcome from them.

Things Electrical in Montreal are still to the front, as indeed they should be at this time. During the week Mr. Chauncy Belknap, of the Thomson-Houston Company, at Boston, Mass., together with Mr. John H. Waterman, an electrical engineer of the same company, have been in town on matters relative to the coming exhibition, and also in connection with the increasing business of their firm in the Dominion. The Thomson-Houston Company, it is evident, will have a very complete exhibit. General Barney, of New York, is expected here daily, and on his arrival will take complete charge of matters directly connected with the exhibition. On Tuesday, Aug. 4, a well-attended meeting of the executive committee of the Citizens' Committee was held in the Windsor Hotel, with Prof. Bovey in the chair. (See notice in another column.) The programme committee had prepared a draft programme, which, however, got somewhat mangled in committee, but that did not prevent the acceptance of one equally good. The principal bone of contention was the question as to whether a ball or a banquet should appear on the list. The meeting at first seemed pretty evenly divided, some evidently being fond of a good dance in pleasant company, while others were equally partial to a good dinner, the further advantage of having an opportunity to listen to after-dinner speeches from some of the distinguished visitors tipped the scale in favor of the banquet, and now the gentlemen from the States who come to the feast must be prepared to entertain the company presumably on the general subject of electricity and its capabilities. There is no doubt but that the banquet will be a tremendous success. Among the items on the programme that of the Fire Department display will be found in the front row for merit. Montreal is proud of her splendid brigade, and on some things even connected with electrical appliances they can give points to their American confrères. At all events, come and see it and make your own remarks. In addition to the programme, lady visitors will have an opportunity of taking in some of the bewitching scenery of the St. Lawrence and Richelieu rivers. Private yachts will be placed at their disposal. They will be able to steam about under the glorious Canadian sky. The committee appointed to revise and prepare a list of the various committee spresented a list which comprises some of the best known names in the Dominion and is of itself proof of the manner in which Canadians in general and Montrealers in particular appreciate the advent of the forthcoming convention and exhibition. Applications for space are still coming in and I learn that the applications for hotel accommodation already exceed anticipation and still they come. It is quite evident that General Barney will find his position here as regards work no sinecure; however, from what I have seen, he has an exhibition committee to co-operate with him which is composed of enthusiastic workers. CIRTCELE.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Charging Accumulators.—What is the actual expense of charging small storage batteries?

This depends on your battery and the terms you are able to make with those who supply the power for the purpose. For details of any special battery you had better inquire of the makers, who have found out by experience exactly what it does cost and could tell you if they wanted to do so.

Magnetism from Jarring.—Why is it that if a bar of steel be held in the plane of the magnetic meridian and struck a blow on the end that permanent magnetism is obtained? E. A. S.

It would seem that the jar for a moment slightly overcomes the mutual attraction of the atoms of the iron in such a way that the weak magnetism of the earth acts upon them with sufficient effect to establish magnetic poles at the ends of the bar.

Electrical Death Grip.—Will you please enlighten us upon the following point? In almost every case of an electrical shock it is reported that the victim was unable to loosen his grasp. Is this because of a paralysis, in which case the hands might fall of their own weight from the wires, or do the hands hold the wire tightly so that it would be difficult for a second person to pull the victim from the wires? According to reports there seems to be a sort of "electrical death grip." E. W. & J. S.

We might put it, as Dr. Arthur Harris in his explanation of the use of electricity in tooth pulling says, that, "since the current is so much quicker in its effect than nervous impulses in the nerve fibers," the brain is taken up too much by the flow of the electricity to be able to direct the muscles. Hence one cannot let go his hold. But in our experience it has never been found that the hands of the victim held fast to the wires or contacts. If the electrodes of a medical coil be held in a vertical position it will be found that when the current has reached a high point, the handles will drop from the hands in synchronism with a sickly smile from the victim.

Laminated Armatures and Field Magnets.—Will you please answer the following questions? (1) In an armature composed of sheet iron discs great care is taken to have each thoroughly insulated from its neighbor; in the case of laminated field magnets, however, I understand no attention is paid to insulating. Why is this? (2) In a single thermo-electric element of bismuth and antimony does the current developed by heating increase proportionately with the cross-section of the metals and the temperature to which they are subjected? (3) What is the approximate voltage of a small current so developed? SUBSCRIBER.

(1) The object of laminating an amature is to avoid Foucault currents flowing lengthwise through the cores, therefore the discs are insulated; as in a properly designed machine there will be only very slight induced currents in the pole pieces, insulation in laminated field magnets is a matter of indifference; the method of construction is frequently used, simply for the purpose of enabling one to employ a good quality of wrought iron conveniently. Some enormously large machines have been constructed abroad, so colossal in size that the magnets have been built up at the spot where the dynamo was to be used. Sometimes the laminæ of field magnets are insulated from each other for the same purpose as in the armature, although the need of it is not so great. (2) The electromotive force of a thermo-electric couple is quite nearly proportional to the difference in temperature between the junction and the opposite end of the bars that constitute the couple. Of course the current increases with the cross-section, as in any other conductor. (3) The electromotive force developed by a bismuth-antimony couple is about 120 micro-volts per degree Centigrade difference of temperature between the heated junction and the other terminals of the bars.

News of the Week.

THE TELEGRAPH.

Typewritten Messages.—At the Chicago office of the Postal Telegraph Company an extra $5 per month is paid to operators who are capable of taking messages direct from the telegraph instrument and putting them down in typewritten copy. A number of Remington typewriters are now in use for this purpose at that office.

Minneapolis, Minn.—The Western Union Telegraph Company's wires in the down-town business district of the city are to be placed in conduits and the work will be finished before the end of this year. The New York officials have notified Supt. McMichael in Minneapolis that they had decided to have the work done at once. Mr. McMichael accordingly applied to the city engineer for a permit to lay conduits in the down-town streets.

Sale of Cœur d'Alene System to the Rocky Mountain Company.—The telephone system in the Cœur d'Alene, with headquarters at Wallace, has been sold by W. S. Norman, of Spokane, Wash., to the Rocky Mountain Bell Telephone Company, of Salt Lake City. D. S. Murray, secretary of the company, who came out from Salt Lake to receive the property, has returned home. The Inland Telephone-Telegraph Company, of Spokane, will continue to exchange business with the Cœur d'Alene system the same as heretofore.

THE TELEPHONE.

District of Columbia.—Mr. Henry R. Miles, superintendent of the telephone and telegraph service of the district, has submitted his report for the past year to the commissioners at Washington. At present there are 150 alarm boxes distributed on seven signal circuits, just twice the number started with in 1875, and 42 telephone earth return circuits, exclusive of the patrol, on which are distributed 62 sets of telephones for use in the various National government departments. The total expenditures during the year for the systems was $18,664.78.

The Central District and Printing Telegraph Company, of Pittsburgh, Pa., which operates the city telephone system, has adopted the plan of giving a Saturday half holiday to a majority of its employés, it having been found that because of this half holiday being generally observed among business people, the work of the telephone girls had grown much lighter after 12 o'clock of each Saturday. Under the arrangement now in force, the girls are divided into two squads, one of which is allowed to depart at two o'clock on Saturday afternoon. The management of the telephone company is much pleased that it is able to extend to its employés the privilege of a breathing spell on Saturday afternoons. The linemen in the employ of the company also come in for a share of the pleasure derived through the new arrangement.

THE ELECTRIC LIGHT.

Morris, Ill., is soon to be lighted by electricity.

Marion, Ind.—A stock company is to erect an electric light plant.

Centerville, Ia., is to install an incandescent electric light plant this fall.

Villisca, Ia.—The vote for the municipal light franchise has resulted in favor of the electric plant.

Luling, Tex.—The electric light proposition has again been taken up by a number of energetic citizens.

Del Rio, Tex.—The electric light system is now in successful operation and the streets present a metropolitan appearance at night.

Berwyn, Ill., is the latest town to take up the electric light question. It is proposed to erect an electric light and fuel gas plant.

Weehawken, N. J.—The Erie company is building an electric light plant at Weehawken to supply the extensive freight piers with light.

Sacramento, Cal.—An isolated electric light plant is to be installed in the state capitol. The number of lights now used is 800 16 c. p. lamps.

Kansas City, Mo., is advertising for bids for the city lighting, the present contract terminating Sept. 1. The bids will be received until Aug. 24.

Grand Rapids, Mich.—The Star Iron Tower Company is to put in a large electric light plant and compete with the other companies in furnishing power and light.

Kalamazoo, Mich.—The City Electric Light Company has contracted to put in 200 lights at the American hotel, where the use of gas will be entirely discontinued.

Omaha, Kan., has awarded a contract for the city lighting to the local Thomson-Houston company. The contract is for 700 20. c. p. incandescent lamps at $20 a year each.

Aberdeen, Wash., is anxious to have a telegraph system. The citizens are indignant at the telegraph company for neglecting Aberdeen for smaller and less wealthy towns.

Duluth, Minn.—The building committee of the school board has let the contract for the electric lighting and wiring of the New Central High School to the Duluth Electric Light and Power Company, for the sum of $2,200.

Desplaines, Ill.—At the last meeting of the village board a resolution was passed notifying F. S. Short that when his electric plant was finished the board would make a contract with him to supply the village with light.

Middleboro, Mass.—Although the contract for lighting the city expired July 31, the authorities have not yet renewed the agreement with the Middleboro Electric Light and Power Company. Many are in favor of the city owning a street lighting plant.

Union City, Pa.—Mr. R. S. Battles, of the Climax Manufacturing Company, states that if a suitable location can be secured this season, the proposed electric light plant will be erected at once. The building is to be 35 by 50 feet in size and the complete plant is to cost about $20,000.

Napa, Cal., has received the following bid for street lighting from the local Thomson-Houston company: Arc lights of 1,200 c. p. until 1 A. M., not less than 20, $10 per month. The company submitted no proposals for incandescent lights, as it supplies arc lights exclusively.

St. Louis, Mo.—The report that the Thomson-Houston Electric Company and the Fort Wayne Electric Company have purchased a large interest in the Municipal Electric Light Company of St. Louis has been confirmed by Mr. James Campbell, a local broker, who has engineered several similar deals.

Seymour, Ind.—The City Treasurer's report of the cost of the city's lighting plant for the past year is as follows: $73.33 per year per light of 48 lamps of 2,000 c. p., making a total of $3,533. The plant has a capacity of 68 lights of the Westinghouse system, and is operated upon the moonlight schedule.

Bloomington, Ill.—Work upon a second system of electric railway in this city and Normal will probably begin at once. A representative of the Thomson-Houston Electric Company is now in Bloomington, and steps are being taken to form a stock company to construct ten miles of line and equip it with 15 cars.

Columbus, Ga.—The Electric Light Company has installed a new 1,000 light dynamo, and new and more durable shafting and pulleys are being put up, and the capacity of the works is being generally increased. A 250 h. p. compound condensing engine is to be received from the Payne Iron Works, at Elmira, N. Y.

Messrs. Parmly, Mitchell & Co., of 18 Cortlandt street, New York City, have secured the order for the pole line material of the new electric light plant at Greenwich, N. Y. The plant will be both arc and incandescent light, being furnished by a 750-light Westinghouse alternator, and a 50-light Fort Wayne Jenney arc machine.

Des Moines, Ia.—Contracts have been awarded by the Executive Committee of the State Fair Association for a $2,000 steam and power plant and a $5,000 electric light plant. The last contract was awarded to a Davenport firm, which agrees to thoroughly light every portion of the grounds and the buildings with incandescent lights.

San Bernardino, Cal.—There is talk of the boards of trustees of Redlands, Riverside, Colton and San Bernardino combining for the purpose of maintaining a light plant. The waters of the Santa Ana River will afford cheap power to conduct the plant. It would cost about $50,000 to lay a pipe line, and by municipal ownership the four towns would be relieved of paying any exorbitant charges for light.

The Fort Wayne Electric Company, since it has been exploiting the Wood arc system, less than two years, has sold an average of 1,000 arc lights per month. Since June 1 the company has sold 3,850 arc lamps as follows: United States Electric Light and Power Company, Buffalo, N. Y., 120; Complete Electric Construction Company, Weehawken, N. J., 80; Southern Electric Light Company, Philadelphia, Pa., 60; Thomas Grimwood, Atlantic City, N. J., 160; Mutual Electric Light Company, Alliance, O., 40; Detroit (Mich.) Electric Light and Power Company, 80; Fort Wayne Electric Company, Coney Island, N. Y., 50; Intercolonial Railway Company of Canada, Moncton, N. B., 25; Citizens' Electric Light Company, Pueblo, Colo., 80; Jos. P. Witherow, Middlesboro, Ky., 60; Paris (Tex.) Gas and Electric Company, 80; Geo. W. Kelley, Philadelphia, Pa., 60; W. J. Morrison, Toronto, Ont., 15; City of Pulaski, Tenn., 30; J. P. Smith, Peoria, Ill., 160; Louisiana Electric Light Company, New Orleans, La., 600; City of Chicago, Ill., 120; Greenwich (N. Y.) Electric Light and Power Company, 60; Village of Cuyahoga Falls, O., 50; City of Galion, O., 40; City of Wheeling, W. Va., 480; City of Grand Rapids, Mich., 300; City of Chicago, Ill., 600; City of Tacoma, Wash., 120; Fremont (Neb.) Gas and Electric Company, 50; Bessemer Machine and Foundry Company, Birmingham, Ala., 75; People's Gas and Electric Company, Chillicothe, Mo., 50; Municipal Construction Company, Chillicothe, Ill., 60; Brush Electric Company, Buffalo, N. Y., 80; People's Electric Light Company, York, Pa., 60. The total sales of incandescent lamps in the same time amount to 8,750, as follows: Thomas Grimwood, Atlantic City, N. J., 650; Dallas (Tex.) Electric Construction Company, 650; Beloit (Wis.) Electric Light and Power Company, 650; Monticello (Ill.) Electric Light Company, 650; Thomas Spencer, Cumberland, Md., 650; City of Pulaski, Tenn., 650; Frankford Avenue Merchants' Electric Light Company, Philadelphia, Pa., 1,200; Moundsville (W. Va.) Electric Company, 1,200; University of Michigan, Ann Arbor, Mich., 300; Citizens' Electric Light Company, Pueblo, Colo., 1,200; Bessemer Machine and Foundry Company, Birmingham, Ala., 650; Village of Cuyhaga Falls, O., 300.

THE ELECTRIC RAILWAY.

Ione, Cal.—The survey for the road from Ione to Jackson, Amador county, has been contracted for.

Altoona, Pa.—Thomas C. Wiley, of Lancaster, Pa., has contracted to build an electric railway between Altoona and Hollidaysburg, a distance of nine miles.

Hagerstown, Md.—The projectors of the electric railway refuse to build under the franchise passed by the city council. They objected to some of the restrictions.

Nantucket, Mass.—It is stated that an electric railway is to be built between Nantucket and Surfside this fall.

An Important Railway Deal was made in Lockport, N. Y., last week, under which the Lockport Street Railroad Company sold out its entire plant to the United States Railway Equipment and Construction Company of New York. This is the company that will put in the new electric road. The capital stock will be $100,000. Work on the new road was commenced last week.

Gettysburg, Pa.—A company has been chartered for the purpose of constructing an electric railroad to traverse portions of the famous battlefield and thus render sight-seeing an easy matter. As is well known, the site of the battle covers many acres of ground and no better plan than an electric railway could be devised for getting over this ground quickly and easily. The many visitors to the noted spot will insure the success of the venture.

The Citizens' Traction Company, of Pittsburgh, has begun the erection of a power-house for the Sharpsburg extension of its cable line, which is to be operated by electricity. The building will be of brick, 94 by 125 ft., and will be installed in the most approved manner. Westinghouse motors are to be used on this new line. The Citizens' company is very prosperous, and it is the expectation that upon the completion of the Sharpsburgh line there will be a very considerable addition to its revenue.

Little Rock, Ark.—The following details have been obtained of the power plant to be erected by the Little Rock Electric Street Railway Company: The main building is to be 285 × 98 feet and four stories high. There will be installed three Heine safety boilers of 250 h. p. each. In the engine room, on the same floor, are to be two Hamilton Corliss engines of 300 h. p. and 500 h. p. respectively. These are to be connected to the counter-shafting by two mammoth belts 32 inches in length. On the second floor will be placed five 100 h. p. Thomson-Houston dynamos and one 500-volt machine to be driven by an Ide engine placed on the same floor. The switchboard at the end of this room is to be handsomely equipped with Thomson-Houston fittings. A large force of men is now engaged in line work for the new system, and it is expected that the plant will be in full operation this summer.

Braddock, Pa., is rejoicing over the acquisition of an electric streetcar system which was put into operation recently. The car outfit consists of three cars, each equipped with Thomson-Houston 15 h. p. motors. The road is two miles in length, extending from the Edgar Thomson Steel Works, at the extreme eastern limit of the town, to Rankin station, at the western limit. The power house is a well-built brick structure and is equipped with an 80 h. p. Thomson-Houston generator and a 150 h. p. Russell & Co. engine. The entire steam plant was installed by this latter company. The Braddock and Turtle Creek R. R. Co. is the title of the corporation, the superintendent of which is Mr. G. T. Stamate, of Pittsburgh. The capital of the Braddock concern is $100,000. It is expected that within the next year the line will be greatly extended. A good business is being done and the management is much encouraged by the condition of affairs.

GENERAL APPLICATIONS OF POWER.

Sixty-H. P. Motor in a Flour Mill.—The Dominion Roller and Flour Mills Company, of Ottawa, Canada, has contracted with the Standard Electric Company of that city for a 60 h. p. electric motor of the Thomson-Houston type. By the terms of the contract the Standard company is to operate the flour mills for 24 hours a day, six days a week. A pressure of 250 volts is to be used. In addition to the large machine a 15-h. p. motor is to be installed for lighter work.

The Transportation of Lumber by Electricity.—A company has been incorporated for the purpose of placing on the market a lumber carrier to be operated by electricity. The apparatus consists simply of a clamp to be swung from trees or other supports on which hangs a cable; the cable is drawn taut, and on it run pulleys from which hang chains carrying the logs about three feet from the ground. The company is now known as the American Log and Lumber Carrier Company, but will change its name to the American Elevated Cable Company. The company was organized with $500,000 capital stock. Its officers are: E. F. Cragin, president; George W. Cole, secretary; J. S. Morse, treasurer. The board of directors is as follows: George W. Cole, E. F. Cragin, James E. Harder, Parker Earle, J. S. Morse, Alfred F. Kelliher, and Ex-Governor Warmouth of Louisiana.

LEGAL NOTE.

The Lamp Patent Suit Appealed.—The United States Electric Lighting Company has filed papers in its appeal to the October term of the recently established Circuit Court of Appeals in the Edison lamp patent suit, in which an opinion was lately given by Judge Wallace.

PERSONALS.

Mr. Eugene F. Phillips, president of the American Electrical Works, Providence, R. I., accompanied by Mrs. Phillips, spent Sunday of last week very pleasantly at Nantucket, where they were guests of Preston C. Nason, of Boston.

Mr. W. H. Churchill, who was some years ago connected with the Edison Electric Light Company as special agent, has now entered the service of the Edison General Electric Company in the same capacity, and will give his time to the organization and installation of central stations.

Mr. Daniel W. Baker, of Newark, N. J., died at his home on Sunday night of last week of apoplexy. Mr. Baker was senior partner of the firm of Baker & Co., well-known as extensive dealers in platinum. He was the father of Mr. C. O. Baker, Jr., whose name is familiar in electrical circles.

Mr. Walter I. Brock, of Quincy, Ill., who has been connected with the Thomson Electric Welding Company, and has been installing welding plants in the West for the past two years, has resigned his position and become associated with Smith, Hill & Company, of Quincy, Ill., builders of automatic engines, power elevators and improved electric elevators.

Mr. George A. McKinlock, well and popularly known to all the members of the electrical fraternity, is still enjoying his bridal tour on the continent, and during the warm days is sojourning in Norway and drifting towards the land of the midnight sun. Both Mr. and Mrs. McKinlock are in the enjoyment of the best of health. Mr. McKinlock's address up to October 15 will be care of Monroe & Co., Rue Scribe, Paris.

Mr. Henry Alexander, the newly elected treasurer of Alexander, Barney & Chapin, left for Europe last Thursday on the Columbia of the Hamburg line. He is taking a flying trip across the Atlantic in order to witness the golden wedding of his mother and father, who reside in Berlin. He will return on the Columbia on her back trip. His brother, Mr. H. A. Alexander, as well as many other friends, wished him *bon voyage*.

EDUCATIONAL NOTE.

Electrical Engineering at Tulane University.—The course in electrical engineering at Tulane University, of Lousiana, at New Orleans, is very fully described in a prospectus just issued by that institution. Prof. Brown Ayres is in charge of the department of physics and electrical engineering. The facilities for the study of electrical engineering here are excellent; the mechanical training is given at the Tulane Mechanical Training School, one of the best equipped of its class in the country, under the supervision of Prof. John M. Ordway, late chairman of the faculty of the Massachusetts Institute of Technology, at Boston. The electrical branches are studied in the physical laboratory, which is probably the best appointed and most perfectly organized laboratory of its kind in the South, and in which the facilities are peculiarly good for the study of electricity. In addition to the laboratory work and theoretical instruction in electricity and magnetism, there is a course of lectures and practical demonstrations and exercises on the application of electricity to lighting and the distribution of power and to telegraphy and telephony. For the purposes of this course, the laboratory has a number of dynamos and motors of different forms and capacities and a variety of telephonic and telegraphic apparatus. Among the more prominent of these machines may be mentioned two Edison compound wound dynamos, with all accessories, which are installed so as to form a complete model of a three-wire system, with its lamps, motors, feeders, pressure wires, ampère meters, indicators, etc.; an alternating current machine of the Stanley type designed by the professor in charge, and constructed largely in the laboratory; a Thomson-Houston arc light dynamo, with its lamps and regulators, and several other arc light machines illustrating devices of construction and the historical development of this class of generators. Several motors are also possessed by the department, a plant of storage batteries, and full sets of measuring instruments. A darkened room with a Bunsen photometer and Methven standard affords means for the study of that branch of the subject. The practical work includes the testing of the machines for conductor and insulation resistance; the study of the law of the electromagnet in dynamo machines; the determination of the strength of field in absolute measure; the mapping of the characteristics of shunt, series and compound machines; the determination of the electrical and commercial efficiencies of dynamos and motors; the determination of the candle powers of arc and incandescent lights, and the study of the influence on them of varying conditions of potential, etc. Some practice is also had in laying out installations and in designing machines and appliances to fulfill definite conditions.

MISCELLANEOUS NOTE.

The Weekly Bulletin of Newspaper and Periodical Literature is the title of a publication the first number of which was issued on July 25 by Benjamin R. Tucker, of 45 Milk street, Boston, Mass. The chief feature of the bulletin is a classified catalogue of all the important articles appearing in the periodical press of the United States and the British Provinces, daily, weekly, monthly, etc. The title of each article is given, the name of the author, when known, the name of the periodical, the number of words in the article, and when necessary a line or two of descriptive matter.

Industrial and Trade Notes.

Messrs. Whitemore & Robinson, electrical engineers, have just completed a series of tests of the candle power of arc lights, and also an inspection of the lighting plant for the city of Haverhill, N. H.

Messrs. R. Thomas & Sons, of East Liverpool, O., dealers in porcelain specialties for electrical purposes, have secured Mr. C. S. Knowles, of 7 Arch street, Boston, Mass., to act as their Eastern agent.

Mr. T. J. Murphy, the well known slate manufacturer, has removed from Columbus avenue to Room 215 in the Electrical Exchange building at 136 Liberty street, where he has some very beautiful designs on exhibition.

Mr. E. T. Orne, of 112 Randolph street, Chicago, Ill., is placing his system of electric speaking tubes in the *Daily Herald* building of that city. He will use 100 or more of the Partrick & Carter Co.'s "New King" annunciator.

Mr. Louis R. Wallis, New England agent of the Buckeye Electric Company, was a caller at our office last week. Mr. Wallis has been very successful in introducing the Buckeye lamp and says its merits have only been half told.

Messrs. Truex & Vail, of 136 Liberty street, New York City, are way behind their orders for swinging ball lightning arresters, but are increasing their facilities. The demand for Walker ammeters, handled exclusively by this company, is constantly on the increase.

The Reliance Safety Water Columns have grown to be very popular with the electric light and street railway people. Among those who have recently adopted the Reliance columns are the East Cleveland Street Railway Company and the new electric light company, at Wheaton, Ill.

The New Haven, Conn., Insulated Wire Company is now running day and night, and have orders on hand for three months ahead. The company's thick braid weatherproof and high grade rubber insulated wires wherever installed have been well received, and duplicate orders are very frequent.

Mr. W. S. Chesley, of 136 Liberty street, New York, will hereafter give his attention to acting as purchasing agent for electric light and power stations, charging a small commission for transacting their business. By this system of purchasing the electric light and power stations will have the advantage of purchasing in wholesale lots, thus saving the profit of the middleman.

Messrs. Huebel and Monger, 286-290 Graham street, Brooklyn, N. Y., are turning out as nice a class of work in bells, push buttons, window and door springs, and electrical household furnishings in general, as it has been our fortune to see. This young company started in April last, and business has been so increased that its works are taxed to their full capacity.

The Mason Regulator Company is doing a larger business than at any time since its incorporation. This company has been sending out a little book entitled a "Key to Tteam Engineering," which has proved so popular that the company has been compelled to print a second edition, and from the orders being daily received it looks as though a third edition might be necessary.

The Standard Underground Cable Company, of Pittsburgh, Pa., has just received an order for $100,000 worth of cable, which is to be used in the city of Minneapolis, Minn., for the laying of electric lighting lines by the Minneapolis Electric Light Company. The Standard Underground people say that business is quite brisk with them at the present time, and their factory is kept running to its full capacity.

Messrs. J. E. Wilson & Co. have just sold a 100 h. p. Rollins engine to the Boston *Daily Journal* Company to run two new 50 h. p. presses, the latter company having decided to increase the size of the paper to 16 pages. Messrs. Wilson have secured the agency for the Lawrence Machine Company's vertical engines and are now prepared to furnish and put in complete steam plants of any size or capacity desired.

Messrs. J. F. Barry & Co., of 52-54 William street, N. Y., have received a very complimentary letter from the syndicate controlling the Lincoln, Neb., street railways, on which roads they have just completed the electric work. The letter says that the work was eminently satisfactory, that the skillful attention of Messrs. Barry & Co. in guarding the company's interest no doubt saved the city of Lincoln many thousands of dollars.

Messrs. Taylor and Walsh, of 100 South Fifth avenue, who have only lately commenced the manufacture of battery cells, must be pleased at the increase in the sales of their fibrous dry battery cells. They sold 1,800 batteries the first week, showing that they have great merit. A sample of one of these batteries has maintained ringing a bell which has been turned on at 8 A. M. daily and cut out about 5:30 P. M., for ten days. It still works, with the chances of a great many more days of life.

The Stratton Separator Company, of 32 Cortlandt street, New York City, has received the following commendatory letter from Prof. William F. M. Gross, professor of experimental engineering at Purdue University, at La Fayette, Ind.: "We have been using for about a year one of your 4-inch separators in connection with the compound engine in our engineering laboratory. Steam for this engine is supplied by boilers located 580 feet away, and notwithstanding the long length of pipe through which it is thus required to pass, it was never found, *by repeated calorimeter tests*, to contain as much as 3% of moisture when the steam passes out of the separator, regardless of the amount of water previously held by the steam."

The Ongley Electric Company's System is meeting with success. The public has recognized the value of the company's reliable watchman's register, which faithfully records the movements of a night or day watchman, and its many adjuncts, viz.: engine stopping device, fire alarm signals, automatic sprinkler protector, etc., etc. Among the latest establishments which have been equipped with the system we may mention the Pennsylvania Railroad Yards, both at Jersey City and Hoboken; Eble & Harter's Brewery, Philadelphia, Pa., and the Appleton Manufacturing Company, of

Brooklyn, N. Y., and we learn that many other large and important concerns have just closed contracts with the Ongley Electric Company. The company will be pleased to see all of its friends at any time at No. 1 Broadway, New York City.

The Pond Engineering Company reports increased activity in the territory tributary to its Chicago and St. Louis offices. In addition to the two 400 h. p. Armington & Sims engines now being furnished the Edison station in Chicago, this company has just started a 250 h. p. Armington & Sims engine in the station of the Cicero & Proviso Electric Railway. This is the second electric railway now in Chicago, both of which are using Armington & Sims engines, furnished by the Pond Engineering Company. The Pond company is also furnishing the Murphysboro Water-Works and Electric Light Company with an Armington & Sims engine of 120 h. p., a complete steam plant for the Grand Ridge (Ill.) Electric Light Company, and one automatic engine of vertical pattern to the Chicago office of the Edison General Electric Company.

The R. D. Nuttall Company, of Allegheny, Pa., has taken steps to increase the capital stock of the company to $500,000, for the purpose of enlarging its plant, extending its business and purchasing the business of the Electric Railway Specialty Company, of New York City. The Electric Railway Specialty Company has been the Eastern agent for the Nuttall company, and the increase is made necessary by the large business which has been turned over to the Nuttall company. Mr. J. F. Porter, manager of the Electric Railway Specialty Company, will remove to Allegheny, where he will give his entire time to the business affairs of the company. Messrs. Carey and Mayer will represent the company on the road. The main office and factory of the company will be at Allegheny, Pa., and the Eastern office and warerooms at 29 Broadway, New York City.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

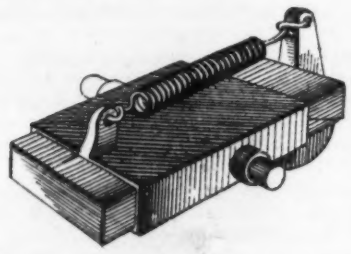
U. S. PATENTS ISSUED AUG. 4, 1891.

11,185. Electric Elevator; Francis B. Perkins, of Boston, Mass. Application for reissue filed June 24, 1891. The combination of an elevator mechanism, an electric motor to actuate the same, a starting and stopping mechanism for said elevator mechanism, a brake mechanism, and an electrically controlled connection connecting the said brake mechanism with said starting and stopping mechanism, whereby the former is made operative by the latter so long as the circuit through said connection is maintained, the said electrically controlled connection being disconnected or broken as soon as the circuit is interrupted, to thereby prevent the said brake mechanism from being operated by operation of the starting and stopping mechanism.

456,940. Electromagnetic Cut-Out; Sylvanus H. Cobb, of Hyde Park, Mass., Assignor to the Electrical Safety Company, of Portland, Me. Application filed Nov. 29, 1890. A current protector for electrical instruments, comprising an electromagnet included in the circuit and acting to establish a connection with ground, a resistance less than the resistance of the magnet and connected to the circuit, a supplementary armature electrically connected to this resistance, operated by the same or another electromagnet in the circuit, and connections, whereby the attraction of the supplementary armature establishes the connection of the resistance with the electromagnet or magnets and ground, thus causing a division of the current between this resistance and the electromagnet or magnets.

456,970. Car Propelled by Electricity; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed Dec. 15, 1890. The combination, with a car, of a propelling motor comprising an armature mounted on or axially placed with reference to a driving axle and connected directly with said axle, and field magnets mounted on side bars connecting the pedestals and journal boxes of the car and upheld by said journal boxes independently of the car body and the main car springs.

456,979. System for Conducting Electric Currents; Edward Britt, of Davenport, Ia., Assignor of one-half to Oswald Hill, of same place. Application filed Oct. 11, 1889. In a system for conducting electric currents, the combination, with a main electrical conductor and a series of distinct sectional electric conductors, of the chair, the metal insulated adjustable bolts supported thereby, the wire connecting each of said bolts with the main conductor, the vertical standards supported upon each chair, the adjustable collar upon each standard, the coiled springs attached to each sectional conductor, and the threaded screw passing through each sectional conductor.



No. 457,226.—Brush Holder for Dynamo-Electric Machines.

457,015. Trolley for Electric Railways; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed March 29, 1890. A trolley for electric railways, having a spring actuated lever carrying rollers or brushes into contact with an overhead line conductor, with a dash-pot connected with the lever for checking and limiting the upward movement of the latter. (See illustration.)

457,016. Electric Car Brake; Edmund Verstraete, of St. Louis, Mo., Assignor of one-half to Peter M. Kling, of same place. Application filed July 26, 1890. An electric car brake, comprising the car axle, the armature and an electromagnet, one of which parts is fixed against rotation and the other of which is secured to the axle so as to rotate therewith, said rotating part being formed in two parts adapted to be fitted and secured together around the axle.

457,030. Electric Clock; Walter J. Menns and Walter J. Dudley, of Everett, Mass., Assignors to the Waltham Electric Clock Company, of New Hampshire. Application filed March 8, 1890. In an electric clock an impelling device consisting of a pivoted arm arranged to bear by its weight against the pendulum during a portion of its vibratory movement in one direction, the said arm being raised or restored to its normal position before the return movement of the pendulum by the armature lever of an electromagnet. This magnet is of the ordinary horseshoe type, and is in a circuit controlled by the pendulum, which has circuit breaking and making devices thereon. The impelling device is supported or held in its highest position by a catch or movable detent member pivoted on the impelling device, and co-operating with a stationary detent member, and the detent is arranged to be disengaged by the pendulum when near the end of its vibration toward said impelling device.

457,036. Electric Motor for Street Cars; Elihu Thomson, of Swampscott, and Edwin Wilbur Rice, Jr., of Lynn, Mass. Application filed Jan. 19, 1891. An electric motor for railway cars, comprising a field magnet frame having journal bearings for the axle, extensions for the armature bearings, and interiorly projecting poles arranged in pairs above and below the armature, field coils surrounding the respective pairs of poles, and an armature substantially filling the space inclosed by said poles and field coils and geared to the axles through a single reduction gearing comprising a pinion on the armature shaft and a gear wheel on the axle.

457,058. Electric Track Signal; Myron W. Parrish, of Detroit, Mich. Application filed Aug. 8, 1890. The invention consists in arranging the tread bars by which the circuit controllers are operated on the outside of the rails of the track higher than the upper surface of said rails and by the side thereof, so that the tread part of the wheels, instead of the flanges, will operate the said bars.

457,065. Armature for Dynamos or Motors, and Method of Winding the Same; Ferdinand A. Wessel, of Brooklyn, Assignor to the Excelsior Electric Company, of New York. Application filed Nov. 15, 1889. The method in winding drum armatures having two sets of coils or bobbins applied in two layers to the armature, consisting in winding the sets alternately and winding the bobbins of each set directly upon the armature on one side thereof and over the previously applied portion of another bobbin of the other set upon the other side thereof.

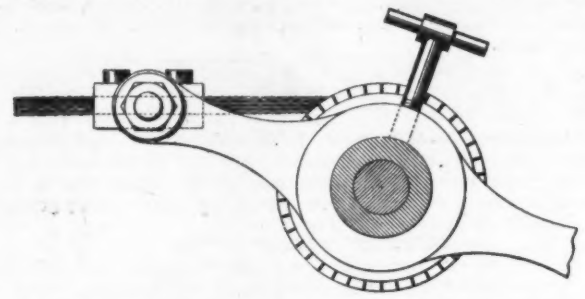
457,067. Electric Car Brake; Craig Ritchie Arnold, of Sharon Hill, Pa. Application filed Aug. 21, 1890. The invention consists in utilizing the car wheels to form parts of a closed magnetic circuit from one pole to the other of the brake magnet, so as to constitute a part of a closed magnetic circuit armature for the magnet.

457,072. Incandescent-Lamp So Waldo C. Bryant, of Bridgeport, Conn. Application filed March 9, 1891 In combination, an incandescent lamp having a rib and a socket provided with clamping arms having inwar ly turned ends and lugs formed by striking in the metal of the arms, between which and the inwardly turned ends said rib is engaged in use.

457,090. Rheostat; John A. Mosher, of Abilene, Kan., Assignor to the Mosher Arc Lamp Company, of same place. Application filed Nov. 5, 1890. A rheostat comprising discs provided around their peripheries with a plurality of holes, carbon rods passed through said holes, a central separating bolt, nuts near each end thereof upon opposite sides of said discs, and clamps each in two parts adjustably held together and around the carbon rods and alternately connecting them in pairs.

457,102. Electric Railway Motor; Norman C. Bassett, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company of Connecticut. Application filed March 30, 1891. An electric railway motor having a field magnet frame or shell inclosing the armature on all sides, and having projecting inwardly therefrom an upper pole surrounded by a field coil and a lower unwound pole.

457,105. Electric-Conductor Support; Eben Moody Boynton, of West Newbury, Mass., Assignor to the Boynton Bicycle Railway Company. Application filed Oct. 17, 1890. The combination, with an overhead electric conductor, of a support and protector consisting of a rail having a longitudinal groove cut through its inferior face, in which groove the said conductor is held by lateral pressure, and a surrounding metal covering serving as a guide.



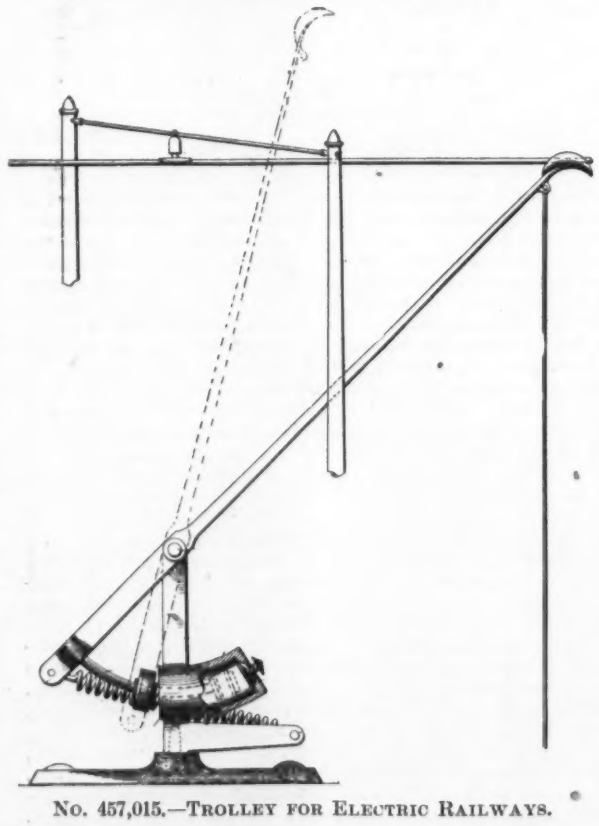
No. 457,327.—Commutator or Contact Brush.

457,106. Electric Conductor; Eben Moody Boynton, of West Newbury, Mass., Assignor to the Boynton Bicycle Railway Company. Application filed Dec. 15, 1890. As a means for guiding a bicycle car and conveying the electric current to the motor in same, a compound overhead beam consisting of two rails, one of which carries the outgoing and the other the returning current, said beams being insulated one from another and from their supports.

457,109. Socket for Incandescent Electric Lamps; John Criggal, of Newark, N. J. Application filed Jan. 3, 1891. The invention consists of an incandescent electric lamp provided with a base of suitable non-conducting material, said base having a screw threaded shank and metallic eyes at the opposite points of said shank, in combination with a socket formed of spiral retaining wires that engage the threaded shank and the eyes of the same, so as to firmly interlock therewith and transmit the current to the filament in the lamp.

457,110. Mechanical Switch for Electric Systems; Christian Dauffenbach, of Milwaukee, Wis. Application filed March 3, 1891. The combination of an inclosing box, binding posts for main and loop wires of a high-tension electric system, spring controlled levers pivoted to the binding posts of one set of wires, and designed for contact with the binding posts of the other set of wires, a slide bar, a cam fast on the side bar in opposition to the levers, and guides for these levers in the form of flanges that extend laterally from the cam.

457,116. Galvanic Battery; John Randolph Hard, of New York. Application filed Feb. 6, 1891. A closed galvanic cell having a gas outlet in its closing stopper, and a self-closing valve controlling said outlet, said valve opening outwardly.



No. 457,015.—Trolley for Electric Railways.

457,127. Electric Hand Fan; William B. Luce, of Boston, Mass. Application filed May 19, 1890. The invention consists in a fan comprising a handle or holder, a movable fan or series of fan blades mounted to rotate in bearings on the holder, an electric motor also mounted upon the holder and arranged to rotate the shaft of the fan, suitable connections between said motor and a source of electricity, whereby the motor may be driven, and a circuit closing and breaking device located within or upon the holder.

457,135. Railway Signal; William C. Serrell, of Bayonne, N. J. Application filed May 18, 1891. In this invention the batteries are placed at intervals along the line, and are connected in such a manner that the batteries in their normal position oppose each other, and the alarm mechanism upon the engine is only brought into action when the circuit is closed through two trains when they come nearer than the prescribed distance.

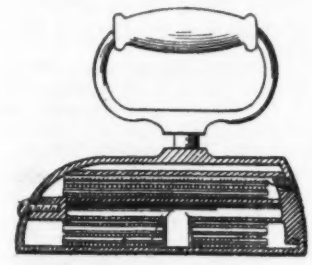
457,141. Electric Arc Lamp; Xavier Wertz, of New York. Application filed Dec. 5, 1889. The invention consists of an electric lamp composed of a closed glass bulb or globe from which the air has been exhausted, conducting wires leading into the globe, and of two carbon pencils which are supported by suitable holders on said conducting wires in such a manner that a voltaic arc is formed by the contact faces of said pencils when the current passes through the carbons. The inner carbon pencil is preferably provided with a disc-shaped head, which rests on the edge of the outer cylindrical carbon, which latter surrounds the shank of the inner carbon, and is separated from the same by a layer of suitable insulating material.

457,151. Coupling for Electric Incandescent Lamps; Isaac J. Flagg, of Clinton, Mass. Application filed March 13, 1891. In accordance with this invention the electric coupling comprises two tubular halves or portions adapted to be screwed or otherwise connected together. One half or portion may be stationary and is connected to the circuit wires, and the other half or portion, which is detachable, is connected with the wires leading to the lamp, so that when it is desired to renew a lamp this detachable half or portion may be removed and another like half or portion having connected with it a new lamp substituted therefor.

457,164. Electric Smoothing Iron; Willis Mitchell, of Malden, Mass., Assignor to the Butterfield-Mitchell Electric Heating Company. Application filed Nov. 21, 1890. A smoothing iron for tailors' and laundry use having a hollow body and a removable plate, and a core removable with said plate and having supports which rest on the bottom of said body, and a wire wound about the core and forming part of an electric circuit, the wire being held above the bottom. (See illustration.)

457,226. Brush Holder for Dynamo-Electric Machines; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed Dec. 18, 1889. The brush holder consists of a box open at its ends and pivotally supported at points between its ends so that it may oscillate or incline in either direction relatively to the commutator. A commutator brush adapted to pass freely through said box bears on the commutator with a yielding pressure. (See illustration.)

457,239. Printing Telegraph; Henry Van Hovenbergh, of Elizabeth, N. J., Assignor to the Baltimore & Ohio Telegraph Company, of Baltimore, Md. Application filed April 16, 1885. In a printing telegraph instrument, a type-wheel-controlling device,



No. 457,164.—Electric Smoothing Iron.

consisting of the combination of a scape wheel, an anchor applied thereto, an armature for controlling the movements of said anchor, a permanent magnet polarizing said armature, and two single-coil electromagnets for controlling the movements of said armature.

457,240. Electric Railway; Samuel E. Wheatley and John W. Schlosser, of Washington, D. C., Assignors to the Wheless Electric Railway Company, of the same place. Application filed April 2, 1891. In an electric railway system, a continuous main-line conductor or lead from the generator, in combination with a series of working conductors arranged end to end, a switch for each working conductor to connect the same temporarily with the main line, a mechanism actuated by the advancing car to close the switch, and an electromagnet in the working circuit to hold the switch in a closed condition until said circuit is opened at another point.

457,296. Electric-Fence-Station Device; David H. Wilson, of Normal, Assignor to the American Electric Fence Company, of Chicago, Ill. Application filed Aug. 25, 1890. In an electrical appliance for generating and maintaining an induced current of electricity, the combination of a primary battery, a circuit breaker, and an induction coil contained in the circuit of such primary battery, and a condenser, one of the wires connecting such condenser with such circuit extending from the circuit upon one side of the circuit breaker and the other of such wires extending therefrom from the other side of such circuit breaker, and secondary wires extending from the induction coil, one of such wires being grounded and the other thereof extending around the coils of a magneto-electric bell and to the fence wire, the hammer of such bell being adapted to move synchronously with the armature of the circuit breaker.

457,300. Electric Switch; Waldo C. Bryant, of Bridgeport, Conn., Assignor to the Bryant Electric Company, of same place. Application filed April 8, 1891. In an electric switch, a tilting contact bar having a central table formed integral therewith, a rotary vertically movable spindle having an operating arm, and a spring acting to hold said arm in contact with the table, so as to tilt the contact bar quickly when said arm is moved past either of the pivotal points.

457,301. Electric Switch; Lewis D. Castor, of Philadelphia, Pa., Assignor to William H. Weston & Co., of same place. Application filed May 20, 1891. The invention consists of an electric switch constructed of two pairs of metal clips, each pair forming a circuit-terminal, and an inverted U-shaped blade, whose ends are adapted to enter between said clips respectively, completing the circuit through a fusible connection on the end of one of the terminals, said blade being carried by a spring which is attached at one end to an operating lever, and adapted to be engaged at the opposite end by a lip or projection on said lever, whereby the circuit may be broken.

457,327. Commutator or Contact Brush; Leonard Paget, of New York, Assignor to Charles J. Kintnet, of same place. Application filed Sept. 25, 1889. A commutator brush composed of one or more layers of wire gauze or fabric having the individual wires located in lines diagonal to the axis of the commutator. (See illustration.)

457,330. Automatic Brush Shifter for Dynamo-Electric Machines; Thomas E. Adams, of Cleveland, O., Assignor to the Brush Electric Company. Application filed Sept. 16, 1887. In a dynamo-electric generator having a current regulator in a shunt around the field magnets, a brush carrier controlled by the differential action of the currents in the field circuit and the governing shunt, and a graduated check weight acting upon the brush carrier for determining the extent of shift of the brushes for a given change of load.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1866—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.